The Blast Furnace and Steel Plant

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The Blast Furnace and Steel Plant

Vol. XIII PITTSBURGH, PA., MARCH, 1925 No. 3

WASTES CLASSIFIED

By HERBERT HOOVER, Secretary of Commerce

The kinds of waste that cause costly losses may be roughly catalogued as follows:

Waste from the speculation, relaxation of effort and extravagance of booms with the infinite waste from unemployment and bankruptcy which comes with the inevitable slump.

Wastes from excessive seasonal character of production and distribution.

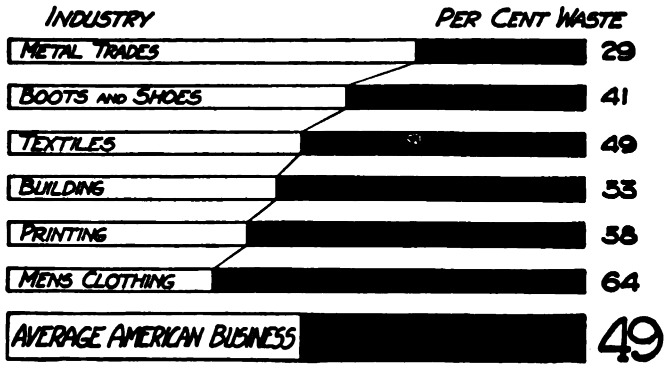
Waste caused through lack of information as to national stocks of production and consumption with its attendant risk and speculation.

Waste due to disorderly marketing, particularly of perishables, with its attendant gluts and famines.

Waste due to too many links in the distribution chain and too many chains in the system.

Waste due to bad credit.

Waste due to destructive competition of people who are in fact exhausting their capital through little understanding of the fundamentals of the business in which they are engaged.



Waste from lack of standards of quality and grades.

Waste from unnecessary multiplication of terms, sizes and varieties.

Waste from the lack of uniformity of business practices in terms and documents, with the resultant misunderstandings, frauds and disputes.

Wastes due to deterioration of commodities.

Waste due to inadequate transportation and terminals, to inefficient loading and shipping and unnecessary haulage.

Waste due to enormous expenditure of effort and money in advertising and sales promotion effort, without adequate basic information on which to base sales promotion.

Waste due to unfair practices of a small minority.

A multitude of wastes in use of materials, in unnecessary fire destruction, in traffic accidents and many other directions.

These wastes are not the small change of industry and commerce. There is scarcely a step in this accomplishment of squeezing out waste which does not interpret itself in millions of dollars of annual saving.

Rolling Rails—History*

Transportation the Life of Business

By G. P. RAIDABAUGH†

NEARLY two centuries before the introduction of the locomotive steam engine, the Colonies of the North of England, made use of wooden rail trams or wagon ways for the purpose of reducing the labor of drawing coals from the pit's mouth to the place of shipment.

The railway rail appeals to the imagination of everyone interested in steel. The rail more than any other form of rolled product is familiar to us all; familiar perhaps because it is the firm base upon which our modern civilization rests and has its being. Without modern steel rails, and all that the modern rail implies—heavy rolling stock, tremendous concentration of power into enormous moving power plants called locomotives, our railroads could not function.

To fully comprehend the advances which steel mill engineers have made during the more than 150 years involved, it is necessary to hark back into the pages of history. That is the purpose of these articles.

At first these roads were merely rough timbers buried in the roadway. Later, sleepers with wooden rails, Fig. 1, R^1, were used. With this arrangement the removal of a broken or worn out rail injured the sleepers in consequence of the peg hole, h, becoming too large; this condition was improved by nailing an upper rail Fig. 2, R^2 onto the lower rail R^1, when the upper rail would be frequently renewed without injury to the sleepers, S.

From descriptions that have come down to us of these old tramways, we learn that the benefit of the use of irons as a track was known as the following abstract from one of them proves: "When the draft was harder than usual in consequence of a steep ascent or a sharp curve in its line, friction was diminished by nailing to the wooden rails thin plates of malleable iron." Fig. 2 plate.

But we should remember that they could not have been more than roughly forged plates such as we of today would consign to the scrap pile. One writer in the year 1672, described a wooden railway which he had seen at Newcastle: "The manner of the carriage is by laying down rails of timber from the Colony to the River exactly straight and parallel, and bulky carts are made with rowlets fitting these rails, whereby the carriage is so easy that one horse will draw four or five chaldrons of coal." These old wooden tramways continued in use for about 150 years without any further improvement.

It is a very interesting study to trace the development of the railway rail from the roughly forged plates of malleable iron which went into use about 250 years ago, to the highly finished and well shaped rails of today.

During the more than 150 years that intervened between the time the first crude wooden tramways went into use and the time about 1767 when the first iron rails were used, there were a few attempts made to introduce stone rails instead of the wooden rails, but it was soon found that what the stone ways gained in durability they lost in smoothness.

The first great advance towards our present system was by the introduction of cast iron plates upon the wooden rails.

This advance, one of the early writers upon the subject of railways tells us was the result of accident rather than of design, and says about the year 1767, when the price of iron was very low it occurred to the proprietors of the Colebrook Dale Iron Works as a means of keeping their furnaces at work, to cast bars in such shape as to admit of them being laid down on a wooden railway in use at the works. This it was thought would save the expense of repairs to the railway, but that if a sudden rise should take place in the price of iron the rails could be taken up and sold as pigs.

These plates were 5 ft. long, 4 in. wide and 1¼ in. thick and they were cast with these holes in them for convenience of nailing then to the wooden rails. The road was said to be successful and it was pointed out as an advantage (which we would now consider a great misfortune) that vehicles could be turned off the track with great ease in consequence of the absence of guiding flange.

It is a historical fact that the rail shown above is a correct representation of the first iron rails that went into use.

These plate rails later when cast iron came into use were called strap rails and continued in use to some extent at least for more than 100 years.

About the year 1776 the Colebrook Dale rail was improved by the addition of an upright flange rising 3 in. above the path of the wagon wheels, these rails were laid down upon cross sleeper or longitudinal sills with the flange turned inward. See Fig. 4.

And still further improvement in 1793 by the addition of brackets to support the flange and ribs on beads cast on the bottom of the rail to strengthen the rail between the supports, which by this time were stone blocks under each end of the rail. See Fig. 5.

Also showing cross section of rail at A and B, these rails were cast three feet long. The stone blocks, C, used under the ends of the rails were 18 in. to 24 in. square and 8 to 10 in. deep.

The rails were secured to the stone blocks with spikes driven into hard wood plugs which were inserted in the hole, B, in the stone blocks. Rails of this construction did not prove to be satisfactory as stones and dirt would accumulate upon the flat surface of the rail at D, which caused much friction and when higher speeds were required tended to throw the carriage off the line.

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*The data upon which this series of articles is based is furnished by Joseph Scholl, Roll Superintendent, Wheeling Steel Corporation, Portsmouth, O.

†Sparrows Point, Md.

A number of these old cast iron rails may be seen in the B. & O. Railroad's collection of old railway appliances.

The defects of the plate rails were remedied by the introduction of edge rails No. 1 patented in England by William Jessop in the year 1789. This rail is fish bellied and was supported upon stone on wooden blocks, the ends of the rail having a flat base for a short distance where they rested on the blocks to which they were secured in the same manner as shown for the plate rail.

No. 7 cast iron, edge rails 1797. These rails are supported in cast iron chairs; these are said to be the first chairs adopted. The rails are secured to the chairs by bolts through the stem, and chairs spiked down to stone blocks or sleepers.

Fig. 8 cast iron edge rail 1802, rails cast 4 ft. 6 in. long. They were of oval section the larger diameter being vertical.

And beneath each end of the rail a dove-tailed block A, which fitted into a cast iron chair or sill B, this sill was imbedded in the roadway; the wheel had a grooved tire fitting loosely on the rail, but it was soon found that the groove became so deepened by wear as to fit the wheel tightly and this caused much friction. An attempt was made to remedy this by making the bearing surface of the rail flat and the wheel made to correspond to it.

Fig. 9. A cast iron tram rail designed to be laid without the use of bolts or spikes; pins "A" are cast on the under side of the rail at the ends where they rest upon the stone blocks C. These blocks have holes drilled in them to fit the pins, the joints between rails are dovetailed as shown at B. This, and the pins fitting into the stone supports does away with the necessity of any other form of joint fixture.

Also cast iron plate rail with a curved flange and a bead cast under the tread to add strength, these rails are secured to the stone supports in the usual way.

Fig. 10 cast iron edge rail patented by Losh and George Stevenson, England, 1816. Mr. William Strickland, an engineer who was sent abroad about the year 1825 to examine the English Railways, describes this rail as four foot long, a fish bellied rail 5 in. deep at the center, A; 2 in. deep at the ends, B, where they rest in the chairs, C, the ends of the rail cast solid formed to make a half lap, joint D, and secured in the chairs by pins, E, some of the old prints showing that a wooden pin was used, F, showing cross section of rail at center of fish belly A.

Cast iron rails were used for many years after this time. A patent was granted to Mr. John W. Bay, of Harrisburg, Pa., in 1844 for a cast iron rail to be cast with a wrought iron bar in the head for strength.

About 1846 the three cast iron rails shown below were proposed for use on American railroads. These rails were to be cast 10 ft. long, the manner of securing them in the track is clearly shown by the drawings.

We do not find that there were a great many of the cast iron rails used upon our early American railroads. We know that a portion of what is now a branch of the Northern Central Railroad running from Sunbury to Shamokin, Pa., was first laid with them,

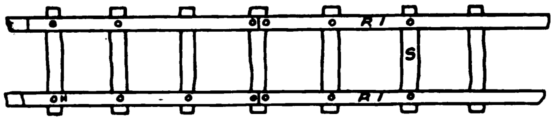


Fig. 1

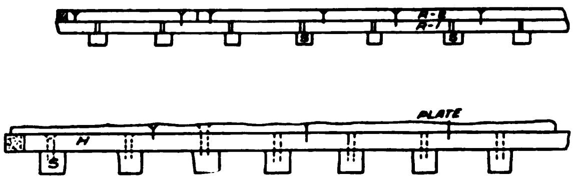


Fig. 2

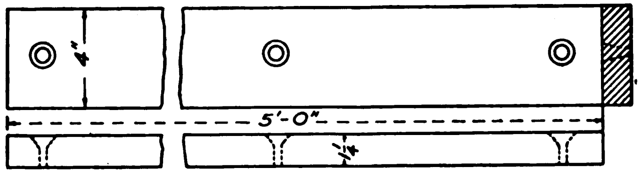


Fig. 3

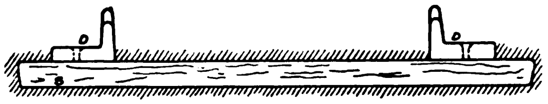


Fig. 4

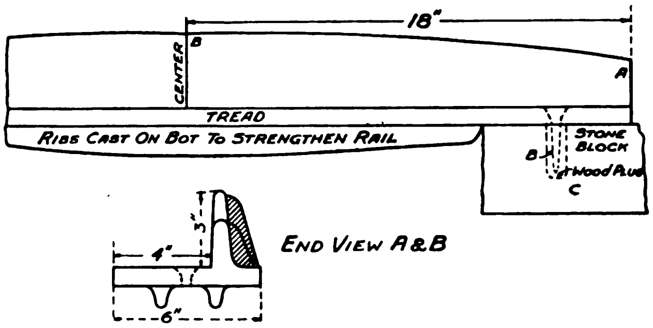


Fig. 5

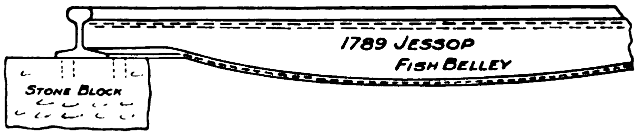


Fig. 6

FIG. 1—*The first rail construction; rough timbers buried in the roadway.* FIG. 2—*The timber rail was improved by nailing on an upper rail. Shows the re-inforcing with iron strips for use on curves.* FIG. 3—*The first great advance; cast-iron plates were fastened to the wooden rail.* FIG. 4—*The origin of the flange.* FIG. 5—*Supporting brackets appear in 1793, followed by strengthening ribs.* FIG. 6—*In 1789 edge rails were patented by William Jessup.*

but the cast iron rails were not without strong advocates, for as late as sometime between the year 1846 and 1850, Mr. T. C. Traubvine, a prominent railway engineer of that time recommended the use of cast iron rails upon a hundred miles of railroad he was then constructing.

Rails of malleable iron of the square or flat form were laid down about the year 1808, this being the only form the rolling machinery of that time could produce.

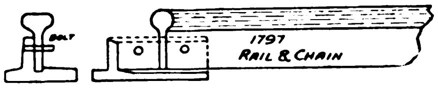


Fig. 7

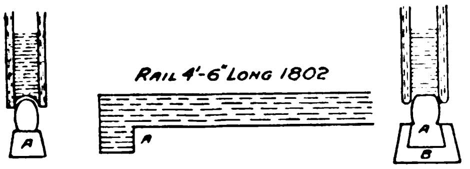
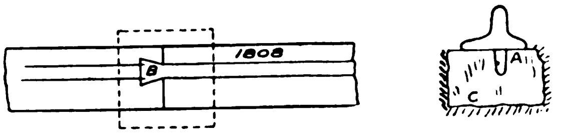


Fig. 8



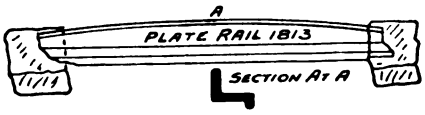


Fig. 9

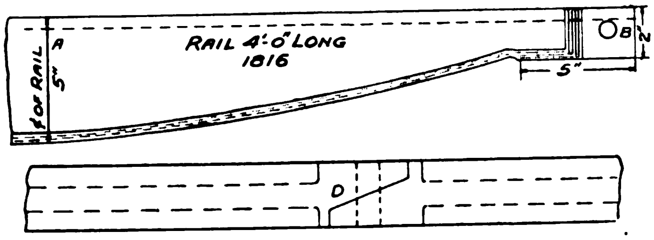


Fig. 10

FIG. 7—*Cast-iron edge rails, supported in cast-iron chairs. Cast-iron edge rails* 1802—*cast* 4 *ft.* 6 *in. long.* FIG. 8—*The cast-iron rails were placed on sills imbedded in the roadway.* FIG. 9—*No bolts or spikes were used in this construction. Cast-iron plate rail with curved flange.* FIG. 10—*Cast-iron edge-rail patented in England,* 1816.

These rails were flat bars of iron, A, 2 in. to 3 in. wide, ½ in to ¾ in. thick, with holes drilled and countersunk for nailing them to the wooden rails, B.

Rails of this form continued in use for many years and especially in this country and are known in history as the strap rail. Fig. 13.

One of our old folk lore stories says "That if anyone when hunting up the history of their ancestors will go back far enough they will come to one of them on a gallows," so, with many of our great railroad systems of today, if they go back they will find a strap rail at the beginning of their existance.

Fig. 14 is a section of the B. & O. track in the year 1831. In this section long granite slabs were substituted for the wooden rails; these slabs were dressed to shape and holes, B, drilled for securing the strap rails, A, to them. These rails were ½ in. and ⅝ in. thick and from 2½ to 4½ in. wide. The granite strings were laid in trenches partially filled with broken stone.

Several of the old stone stringers with the iron affixed can be seen at the National Museum, Washington, D. C.

Strap Rails.

Fig. 15 shows sections of some of the strap rails used on the Amboy Division of the P. R. R. in the year 1831, previous to the introduction of the Stevens rail (as we now know it the Tee rail). These drawings were made from sections of the rail preserved by the Pennsylvania Railroad Company, at their Broad Street Station, Philadelphia, Pa. The flat or strap rail was the only form that could be rolled upon American Rolling mills, up to the year 1844, at which time there were probably more miles of track in America laid with these rails than were laid with all other types of rail.

These rails were very imperfect and hard to keep in the track, as the following extract from a New York newspaper of May 30, 1844:

"Railroad Casualty: The cars on the railroad a short distance East of Rome, New York, came in contact with a snake head (when these strap rails tore loose from the wooden rails or sills to which they were nailed and followed the wheel frequently with force sufficient to penetrate the car floor, they were then called Snake Heads), on Saturday morning which threw several of the passenger cars and the mail car off the track; the crash was tremendous and the cars were torn to splinters."

As late as the year 1868 there were four miles of these rails laid upon wood stringers, this was on a branch of the Marietta and Cincinnati Railroad between Westborough and Hillsborough, Ohio, and we believe is now a part of the B. & O. Southwest system.

Many attempts were made to form a cheap and durable rail by the combination of wrought and cast iron, but no plan was successful until the method was introduced in 1820 of rolling iron into any required shape.

In that year began the development of the wrought iron edge rail. A patent was granted to John Birkenshaw of the Bedlington Iron Works, England, by the English Government, October 20, 1820, pat. No. 4503, for several forms of rolled edge rails. Mr. Birkenshaw did not claim the invention of the mode of operation by which they were rolled into shape, but confined his claims to the right of manufacturing rails of mealleable iron of any length, preferably of 18 ft.

As a matter of interest we insert at this point a drawing of the first set of rolls ever made to roll rails, with a bead for the wheel surface to run upon.

The drawings here shown of the rolls and rail are copies of the plates accompanying the patent specifications which can be seen at the United States Patent Office, Washington, D. C.

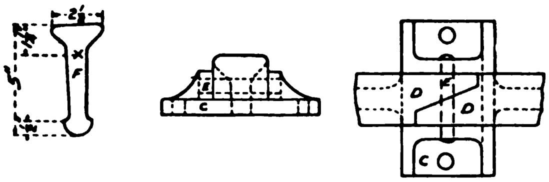


Fig.11

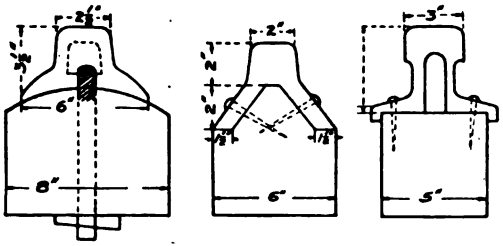


Fig.12

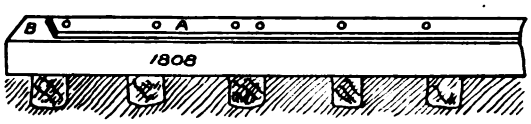


Fig.13

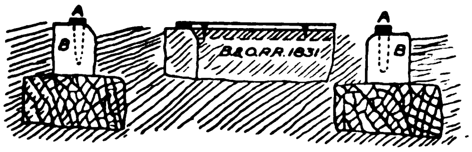


Fig.14

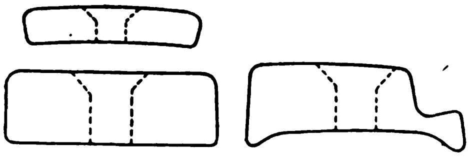


Fig.15

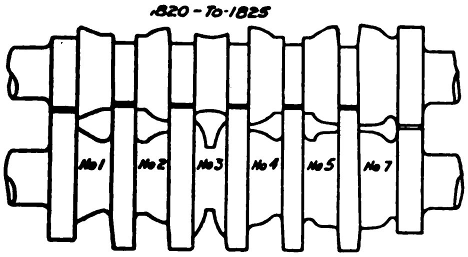


Fig.16

FIG. 11—*Views of rail sections.* FIG. 12—*Three cast-iron rails for use on American railroads* 1846. FIG. 13—*Flat bars of iron, the earliest malleable rails.* FIG. 14—*A section of the B. & O. track in the year* 1831. FIG. 15—*Strap rails used on the P. R. R. in* 1831. FIG. 16—*The first set of rolls designed to roll rails.*

Mr. Birkenshaw desired to roll them in 18 ft. lengths to obviate the evils arising from the great number of joints in the line, and further says, "I propose to weld the ends of the bars together as they are laid down", however, we find no mention anywhere of this being done.

(To be continued)

Outlook for British Iron and Steel Industry

By A. C. Blackall*

At the recent quarterly meeting of the London Iron and Steel Exchange, Sir William J. Larke, director of the National Federation of Iron and Steel Manufacturers, gave, in the course of an address, a very lucid and interesting account of the present European steel situation and of the future prospects of the industry in Great Britain.

Sir William pointed out that from the British standpoint the center of interest must be the European producing countries, for America is fully engaged "in an internal industrial boom which is likely to last for some time to come." In Germany railway rates are about one-fourth of what they are in the United Kingdom, labor there costs about one-half what it costs in Britain, the standard of living is lower, and the hours of work are longer.

Under normal conditions Germany can absorb about 80 per cent of her production, leaving less than 3,000,000 tons for export. Before the war France exported approximately 500,000 tons of iron and steel, but as a result of the rearrangement under the Treaty of Versailles her exporting surplus will be 5,000,000 tons. In the past Lorraine's outlet has been Germany, her works supplying the raw material for Germany's finishing industry. France desires that Lorraine shall re-establish her old connections. Germany, on her part, while willing to import from Lorraine, insists that the amount of the imports shall be determined by the industries concerned. Sir William added that, so far as his knowledge went, the British industry had never received for consideration any proposal which it could either refuse or accept. There is every reason, he added, why the French and German metallurgical industries should come to a definite understanding.

The lecturer showed where hope lies as regards the future of the industry in Great Britain. Having alluded to the fact that since 1913 Britain's steel imports had increased by 10 per cent, while her exports had decreased by 10 per cent, and to the advantages Germany possessed in lower railway rates and wages and lower working hours, he declared that if all in the British industry would pull together and realize the truth of the maximum that high wages are only possible if accompanied by low costs, it would not only hold its own but employ the whole of its producing capacity. Examination of the index figures shows that the cost of iron and steel is at present 36 per cent above the 1913 figure, the coal figure is 60 per cent above, and the general commodity figure 70 per cent above.

"I do not think there is another industry in the country," declared Sir William in conclusion, "which has reduced the costs of its products in the way in which the British iron and steel industry has done." This statement was loudly cheered by those present.

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*London.

Current Literature on Ferrous Metallurgy

By E. H. McCLELLAND*

Arbeitsvorbereitung in der edelstahlindustrie. Hanns Steinhaus. *Stahl u. Eisen*, v. 44, Dec. 18, 1924, p. 1743-1745.

Baking enamel by electricity. Detroit manufacturer has secured large-scale production without sacrificing quality, economy or dependability; temperature control closely supervised. Harry Allen. *Iron Trade*, v. 76, Jan. 15, 1925, p. 220-222.

Beitrag zur frage der kobalt-, chrom-, wolfram-(molybdän-) legierungen. W. Oertel and E. Pakulla. *Stahl u. Eisen*, v. 44, Dec. 18, 1924, p. 1717-1720.

Continuous molding and casting; what conveying machinery can accomplish shown in plant of Warren Foundry Co. at Warren, Ohio. *Iron Age*, v. 115, Jan. 15, 1925, p. 187-191.

Eigenschaften der edelstähle. P. Goerens. *Stahl u. Eisen*, v. 44, Dec. 18, 1924, p. 1645-1659.

Many diagrams, and colored chart showing composition and properties of many alloy steels.

Einfluss von ziehgeschwindigkeit, querschnittabnahme und kohlenstoffgehalt auf die mechanischen eigenschaften gezogener stahldrähte. Kraftbedarf beim ziehen. H. Eicken and W. Heidenhain. *Stahl u. Eisen*, v. 44, Dec. 18, 1924, p. 1687-1694.

Shows graphically the effect of speed of drawing of steel wire.

Ferroalloy industry in 1924. Robert J. Anderson and Laura D. Anderson. *Iron Age*, v. 115, Jan. 1, 1925, p. 65-68.

First units of Gary Tube Company. George F. Tegan. *Iron Age*, v. 115, Jan. 1, 1925, p. 39-41.

Subsidiary of National Tube Company, increasing capacity 30%.

Formungsvorgänge beim rundwalzen von stahl mit wechselndem kohlenstoffgehalt. O. Emicke and M. Rodenbach. *Stahl u. Eisen*, v. 44, Dec. 18, 1924, p. 1679-1681.

Getting castings out on schedule. *Iron Age*, v. 115, Jan. 15, 1925, p. 193-196.

Härtebiegeprobe als chargenkontrolle in der edelstahlerzeugung mit besonderer berücksichtigung der unlegierten werkzeugstähle. G. Klein and W. Aichholzer. *Stahl u. Eisen*, v. 44, Dec. 18, 1924, p. 1734-1739.

High temperature insulation; a plain statement of fundamentals in the problem of reducing heat losses from industrial furnaces. *Iron Trade*, v. 76, Jan. 8, 1925, p. 151-153.

Inspection standards for steel castings. W. J. Corbitt. *Iron Age*, v. 115, Jan. 8, 1925, p. 115-119.

Specifications of the Electric Steel Founders' Research Group.

Kaltwalzen von edelstahl. Anton Pomp. *Stahl u. Eisen*, v. 44, Dec. 18, 1924, p. 1694-1696.

With micrographs showing effect of cold rolling.

Manufacture and uses of stainless iron. H. S. Primrose. *Iron and Coal Trades Rev.*, v. 110, Jan. 2, 1925, p. 18-19.

Includes hot rolling, forging, annealing, cold rolling, and drawing.

Mechanische eigenschaften einiger schnellstähle im vergleich zu ihrer schnittleistung. W. Oertel and F. Pölzguter. *Stahl u. Eisen*, v. 44, Dec. 18, 1924, p. 1708-1713.

More by-product coke plants for iron industry. *Iron Age*, v. 115, Jan. 8, 1925, p. 128-130.

Statistics and list of plants in United States.

Neue beiträge zur kenntnis des tiegelzementstahls. H. Neuhauss. *Stahl u. Eisen*, v. 44, Dec. 18, 1924, p. 1664-1668.

New capacity in iron and steel plants. *Iron Age*, v. 115, Jan. 1, 1925, p. 81-88.

Lists additions during 1924 and gives some estimates for 1925.

New dip test for zinc coated ferrous articles. C. J. Wernlund. *Metal Ind.*, v. 23, Jan. 1925, p. 13-14.

Old order changeth. E. L. Shaner. *Iron Trade*, v. 76, Jan. 1, 1925, p. 3-7.

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Rekristallisation von kohlenstoffstählen und legierten stählen. W. Schneider and E. Houdremont. *Stahl u. Eisen*, v. 44, Dec. 18, 1924, p. 1681-1687.

The alloy steels investigated include those containing manganese, chromium-nickel, and chromium-tungsten.

Research method for blast furnaces. Wallace G. Imhoff and Donald E. Ackerman. *Iron Age*, v. 115, Jan. 15, 1925, p. 203-211.

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Reversing regenerative ovens in Europe. C. H. Tupholme. *Canadian Chem. and Met.*, v. 9, Jan. 1925, p. 13-15.

Stahlherstellungsverfahren unter den besonderen gesichtspunkte der edelstahlerzeugung. W. Eilender, *Stahl u. Eisen*, v. 44, Dec. 18, 1924, p. 1637-1644.

Influence of gases, deoxidation, slag, and discussion of various manufacturing processes.

Steel capacity in the United States; where, how much and what is made. *Iron Age*, v. 115, Jan. 1, 1925, p. 9-18.

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Discusses the term "edelstahl", used to designate certain refined steels and high-grade alloy steels.

Trend in metallurgy last year; technical developments in steel, cast iron and alloys; larger open-hearth furnaces; progress in research. C. E. MacQuigg. *Iron Age*, v. 115, Jan. 1, 1925, p. 61-64.

Includes list of references.

Trend of expansion is westward. John D. Knox. *Iron Trade*, v. 76, Jan. 1, 1925, p. 60-63, 117.

Steelworks construction during 1924.

Twenty-five years of progress in mechanical equipment for foundries. G. P. Fisher. *Iron Age*, v. 115, Jan. 1, 1925, p. 41-42.

Ueber das härten von stahl. F. Rapatz and H. Pollack. *Stahl u. Eisen*, v. 44, Dec. 18, 1924, p. 1698-1703.

Ueber den einfluss der allgemein als schädlich angesehenen beimengungen auf die hartung des werkzeugstahls. E. Maurer and W. Haufe. *Stahl u. Eisen*, v. 44, Dec. 18, 1924, p. 1721-1726.

Ueber die eigenschaften der edelstähle bei den technischen formgebungsbedingungen. E. Siebel. *Stahl u. Eisen*, v. 44, Dec. 18, 1924, p. 1675-1678.

Vanadin in baustählen. R. Hohage and A. Grützner. *Stahl u. Eisen*, v. 44, Dec. 18, 1924, p. 1713-1717.

Influence of vanadium on carbon and chromium steels, and comparison with chromium-nickel steel.

Vergleichende untersuchungen über das verhalten von edelstahl beim schmieden unter dem hammer und unter der presse. F. Pacher and F. Schmitz. *Stahl u. Eisen*, v. 44, Dec. 18, 1924, p. 1668-1674.

(Continued on page 119)

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*Technical Librarian, Carnegie Library, Pittsburgh, Pa.

Iron and Steel Scrap Specifications

For Use by Blast Furnaces, Steel Plants and Foundries

THE Iron and Steel Committee of the N. A. P. A. which recommended the original specifications consisted of the following: G. C. McClure, chairman, American Rolling Mill Company, Middletown, Ohio; L. W. Brice, Continental Motors Corporation, Detroit, Mich.; C. E. Good, Barnsdall Oil Company, Tulsa, Okla.; E. W. Krueger, Union Bed & Spring Company, Chicago, Ill.; W. W. MacMillen, National Malleable & Steel Castings Company, Cleveland, Ohio; C. O. Nelson, Pacific Coast Steel Company, San Francisco, Cal.; P. J. Oliver, Mexican Gulf Oil Company, Tampico, Mexico; H. C. Wickline, Union Steel Casting Company, Pittsburgh, Pa.

Specifications for Scrap for Use in Blast Furnaces.

(*a*) *Pipe Busheling Scrap.* Iron and steel pipe and flues (clean), bedstead tubing and similar material cut 8 in. and under in length, free from galvanized material and foreign metals.

(*b*) *Cast Iron Borings.* Clean cast iron borings free from badly corroded material, lumps, scale, other metals, dirt or foreign material of any kind.

(*c*) *Shoveling Turnings.* Clean, short, steel and wrought iron turnings, drillings or screw cuttings, not over 6 in. in length, free from stringy, bushy or tangled material, corroded or rusty lumps, excessive oil, scale, other metals, dirt or foreign material of any kind.

(*d*) *Mixed Borings and Turnings.* Clean, short, steel and wrought iron turnings, drillings, screw cuttings and cast or malleable iron borings and drillings, not over 6 in. in length, free from stringy, bushy, tangled, corroded material, lumps, excessive oil, scale, other metals, dirt or foreign material of any kind.

(*e*) *Corroded Borings and Turnings.* Corroded and lump borings, turnings and similar stock, free from scale, other metals, dirt or foreign materal of any kind. No dimension to exceed 9 in.

(*f*) *Burnt Iron Scrap.* Old annealing boxes, stools and pots, grate bars and similar burnt cast or malleable iron. No dimension to exceed 9 in., except brake shoes, which may be included.

(*g*) *Mill Scale.* Iron oxide produced in rolling mill practice, from drop forge hammers or from a busheling mill squeezer. Should contain not less than 65 per cent metallic iron and must be reasonably free from dirt, grease and other foreign material.

(*h*) *Mill Cinder.* Cinder from puddling furnaces, and soaking pits. Should contain not less than 50 per cent iron and be reasonably free from dirt and other foreign material.

Specifications for Scrap for Use in Basic Open Hearth Furnaces.

(*a*) *No. 1 Heavy Melting Steel.* Railroad steel such as angles, splices, short rail, couplers, knuckles, draw bars, cut cast steel bolsters, axles, railroad coil and leaf springs (all coil springs to be ½ in. or larger diameter steel), steel castings, steel rolls, croppings from billets, blooms, sheet bars, structural shapes; also heavy rods, bars and plates (not needle or skeleton scrap), boiler plates must be cleaned of lime and free from stay bolts, and not over 18 in. wide or 3 ft. long, heavy forgings and forge butts, rail ends and new mashed pipe ends (original diameter 4 in. and over) thoroughly flattened, oil well drill stems, bits and jars and similar heavy material. Plate scrap ¼ in. and heavier to be cut 12x12 in. All to be ¼ in. or over in thickness, not over 18 in. wide or 5 ft. long.

Regardless of dimensions given above, individual pieces must be sheared into such shape that they will lie flat in a charging box, rods and bars under 2 in. in thickness to be sheared approximately 18 in. in length and all bent or curved pieces to be 12 in. or under in length or width, no piece to weigh less than 5 pounds.

No agricultural shapes, annealing pots, boiler tubes, grate bars, cast iron, malleable iron, sheet iron or curly or unwieldy pieces will be accepted.

Must be free from dirt, excessive rust or scale, or foreign materials of any kind.

Alloy steel scrap may be excluded from these specifications by mutual agreement between buyer and seller.

American Railway Association specifications Nos. 7, 8, 9, 21, 24, 31, 36 and 44 will be accepted.

(*b*) *No. 2 Melting Steel.* Plate scrap such as car sides, automobile frame stock, tank and skelp crops, ⅛ in. and heavier, steel parts of agricultural implements, wagons, buggies and scrapped automobiles, auto and buggy springs cut apart, rods and bars, ½ in. and heavier, punchings, ¼ in. and over in thickness, heavy clippings, new unmashed pipe ends, under 4 in. in diameter, horse shoes and similar material. Car sides and all light plates to be sheared 15x15 in. or under, and all tires and light rods to be 12 in. and under in length. Any curved or twisted pieces must be sheared into such shape that they will lie flat in a charging box and not tangle in handling with a magnet, all to be free from cast iron, malleable iron, burnt scrap, dirt or foreign material of any kind.

Maxmum size 15 in. wide by 3 ft. long.

Alloy steel scrap may be excluded from these specifications by mutual agreement between buyer and seller.

Within the limits of this specification, American Railway Association classificaton No. 25 will be accepted.

(*c*) *Heavy Shoveling Steel Scrap.* Heavy, clean wrought iron and steel scrap, ¼ in. and over in thickness, not exceeding 8 in. in breadth or length and no piece to be less than the equivalent of ½ in. square 3 in. long. To include clean horseshoes, railroad spikes, bolts, nuts, tie plates, etc., boiler, bridge and structural punchings and clippings, small bar and shafting crop ends and other similar material.

To contain no burnt material, cast or malleable scrap, cut pipe and tank, skeleton stock, badly corroded material, or any twisted or tangled scrap. Must be free from foreign metals of all kinds, from galvanized, painted, enameled or other coated stock, and from dirt and rubbish of all kinds.

Must be loaded in separate cars from other grades of scrap.

Alloy steel scrap may be ecluded from these specifications by agreement between the buyer and seller.

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American Railway Association classification No. 58 will be acceptable on this specification.

(*d*) *Short Shoveling Flashings.* Flashings or trimmings from iron or steel forgings. To be 10 in. or under in length, suitable for hand shoveling, to include no tangled or twisted material.

(*e*) *Long Flashings.* Flashings or trimmings from iron or steel forgings, which have been strictly separated to a minimum length of 20 in. and not to exceed a maximum of 36 in. There must be a thickness in some section of each of these flashings of not less than 3/16 in.

(*f*) *Mixed Flashings.* Flashings or trimmings from iron or steel forgings, not over 36 in. in length.

(*g*) *No.* 1 *Busheling.* Iron and soft steel pipes and flues (clean), tank, cut hoops and bands No. 12 gauge and heavier, steel plate punchings and clippings, soft steel and iron forgings and flashings; no dimension over 8 in. To be free from burnt material, hard steel, cast, malleable, galvanized or coated stock of any kind.

American Railway Association specifications Nos. 14 and 58 will be accepted.

(*h*) *No.* 2 *Busheling.* Cut hoops, cotton ties, sheet and similar light material, No. 22 gauge and heavier; no dimension over 8 in. To be free from hard steel, cast, malleable, galvanized or coated material of any kind.

(*i*) *No.* 1 *Selected Rail Scrap.* Standard section "T" and guard rails, 40 lbs. and heavier per yard, not less than 36 in. long, straight lengths, to be free from frog and switch rails not cut apart, and contain no manganese steel scrap or cast welds or attachments of any kind, concrete, dirt or foreign material of any kind.

American Railway Association specifications Nos. 33, 34 and 35 will be accepted.

(*j*) *No.* 1 *Selected Shearing Scrap.* Long length girder rails free from cast welds and attachments, angles from 2 in. up to 6 in., structural shapes in single members from 4 in. up to 9 in., bars ½ in. and over up to 4 in. diameter, and flats ½ in. to 2 in. thick and from 1 in. to 10 in. in width. To be in straight lengths and free from dirt and foreign material of any kind.

(*k*) *Axle Turnings.* Heavy, short first cut turnings from wrought iron and steel railroad car axles or heavy forgings, and rail chips, to weigh not less than 75 lbs. per cu. ft., free from dirt or other foreign material of any kind.

(*l*) *No.* 1 *Machine Shop Turnings.* New, clean steel or wrought iron turnings, free from lumps, badly tangled or matted material, cast iron borings, other metals, excessive oil, dirt or foreign material of any kind. Badly rusted or corroded stock will not be accepted.

(*m*) *No.* 2 *Machine Shop Turnings.* New, clean steel or wrought iron turnings, curly, bushy stock, may contain tangled material, but must be free from bady rusted, lumpy and corroded stock. To contain no cast iron borings, other metals, excessive oil, dirt or foreign material of any kind.

American Railway Association specifications Nos. 50 and 51 will be accepted.

(*n*) *Cast Iron Borings.* New, clean cast iron borings and drillings, free from steel turnings and from badly corroded or rusty material, lumps, oil, scale, other metals, dirt or foreign material of any kind.

(*o*) *Hydraulically Compressed Sheet Scrap.* New, black steel sheet clippings, shearings, skeleton stamping scrap, side and end sheet and tin mill scrap, hydraulically compressed into compact, rectangular packages not to exceed 20 in. longest dimension, weighing not less than 75 lbs. per cu. ft.; must be clean and free from rust, paint or protective coating of any kind. No detinned scrap, electrical sheets or material over.50 per cent silicon will be accepted.

(*p*) *Baled Sheet Scrap.* New, black steel sheet clippings, shearings, skeleton stamping scrap, side and end sheet and tin mill scrap, machine baled into rectangular packages, tied with wire or bands, or sufficiently compact not to come apart in handling with a magnet, not over 20 in. longest dimension, weighing not less than 45 lbs. per cu. ft.; must be clean and free from rust, paint or protective coating of any kind. No detinned scrap, electrical sheets or material over .50 per cent silicon will be accepted.

(*q*) *Hand-bundled Sheet Scrap.* New, black steel sheet clippings, shearings, skeleton stamping scrap, side and end sheet and tin mill scrap, securely tied with not less than two wires or bands into packages not over 18 in. by 18 in. by 3 ft., weighing not over 125 lbs., to be bundled in such a manner that packages will not come apart in handling with a magnet; must be clean and free from rust, paint or protective coating of any kind. No detinned scrap, electrical sheets or material over .50 per cent silicon will be accepted.

(*r*) *Loose Sheet Clippings.* New, black steel sheet clippings, shearings and stampings, 3/16 in. and lighter, free from rust, paint or protective coating of any kind; to be not over 18 in. wide or long or if edge trimmings or shearings to be not over 12 in. by 5 ft. long. No detinned scrap, electrical sheets or material over .50 per cent silicon will be accepted.

(*s*) *Galvanized or Coated Sheet Scrap.* New, clean steel sheet scrap, composed in whole or in part of material having a coating of zinc, paint or protective material. Must be clearly specified as "Galvanized or Coated Scrap," and be classified as above under O, P, Q or R, according to the manner in which it is prepared for shipment.

(*t*) *Detinned Sheet Scrap.* Sheet steel clippings and shearings, originally covered with a protective coating of tin or lead and tin, but from which such foreign metals have been removed.

Must be clean, contain no material over .50 per cent silicon and be free from rusty and corroded stock. Must be clearly specified as "Detinned Scrap" and classified as above under O, P, Q or R, according to the manner in which it is prepared for shipment.

(*u*) *Electrical Sheet Scrap.* New, clean steel sheet scrap, composed in whole or in part of material from .50 per cent to 1.00 per cent silicon. Must be clearly specified as "Electrical Sheet Scrap," and be classified as above under O, P, Q or R, according to the manner in which it is prepared for shipment.

(*v*) *High Silicon Sheet Scrap.* New, clean steel scrap, composed in whole or in part of material over 1.00 per cent silicon. Must be clearly specified as "High Silicon Sheet Scrap" and be classified as above under O, P, Q and R, according to the manner in which it is prepared for shipment.

(*w*) *No.* 1 *Cast Iron Scrap.* To contain all kinds of machinery and similar cast iron scrap, nothing under 10 lbs. or over 500 lbs. in weight nor over 48 in. long or 18 in. wide. To contain no brake shoes, cast iron soil or water pipe, stove scrap or burned iron of any description, and be free from steel parts.

(*x*) *No. 2 Cast Iron Scrap.* To contain all kinds of agricultural implements of cast iron, free from steel parts, nothing under 10 lbs. or over 500 lbs. in weight nor over 48 in. long or 18 in. wide. To contain no stove scrap or burned iron of any description.

(*y*) *No. 3 Cast Iron Scrap.* To consist of cast iron scrap with steel parts attached, nothing under 10 lbs. or over 500 lbs. in weight, nor over 48 in. long or 18 in. wide.

(*z*) *Heavy Breakable Cast Scrap.* Heavy cast iron suitable for breaking under and with Buyer's Drop. Pieces not to exceed 10 tons in weight. Free from anvil blocks, hammer bases and like material, and containing no burnt iron or brake shoes.

Specifications for Low Phosphorus and Low Sulphur Steel Scrap for Use in Acid O. H. Furnaces.

(*a*) *Billet and Bar Crops.* Billet, bloom, axle or bar crops, not over .04 per cent phosphorus or sulphur, not over 0.50 per cent silicon, free from alloys. Not less than 2 in. square or diameter, not over 18 in. wide and sheared to lengths not over 36 in., and no piece to weigh less than 10 lbs. or more than 500 lbs. Must be new material and free from excessive rust.

(*b*) *Plate Crops.* Plate crops, or sheet bar crops, not over .04 per cent phosphorus or sulphur, not over .50 per cent silicon, free from alloys. Not less than ¼ in. thick, not over 18 in. wide and sheared to lengths not over 36 in., and no piece to weigh less than 10 lbs. or more than 350 lbs. To be free from needle and sliver stock. Must be new material and free from excessive rust.

(*c*) *Structural and Miscellaneous Scrap.* Bar ends, forging crops, structural crops, couplers, knuckles, gates, heads, risers and plate shearings smaller and lighter than grade A and B, not over 0.50 per cent silicon, free from alloys. Not less than ¼ in. thick, not over 18 in. wide or 35 in. long and no piece to weigh less than 5 lbs. To be fully described at time of sale and purchase. Must be clean and free from excessive rust.

(*d*) *Tube Scrap.* Tube scrap, seamless or welded, not over .04 per cent phosphorus or sulphur, free from alloys. Not less than No. 12 gauge thickness of wall; if over 4 in. inside diameter they must be mashed flat, and sheared to lengths not over 36 in. Must be only new material that has not been in use for any purpose and free from excessive rust.

(*e*) *Punchings.* Punchings from plate and structural steel scrap, not less than ¼ in. thick and not less than ½ in. diameter, not over .04 per cent phosphorus or sulphur, not over .50 per cent silicon, free from alloys. Must be free from dirt and excessive rust or corrosion.

(*f*) *Car Wheels.* Solid cast steel, forged, pressed or rolled steel car and locomotive wheels, not over 36 in. diameter. Must be free from excessive rust, dirt or grease.

(*g*) *Spring Steel Scrap.* Coil and elliptic springs, made of material not less than ½ in. diameter or ¼ in. thickness, not over 18 in. wide and sheared to lengths not over 36 in. May be assembled or cut apart. Must be free from excessive rust, dirt or grease.

(*h*) *Knuckles and Couplers.* Railroad car and locomotive steel couplers, knucklers and locks stripped clean of all other attachments. Must be free from excessive rust, dirt or grease.

(*i*) *Scrap Tires.* Steel tires from car and locomotive wheels, cut to not over 24 in. long. Must be free from excessive rust, dirt or grease.

(*j*) *Car Bolsters.* Railroad car steel bolsters and side frames, stripped clean of all iron attachments. Not over 24 in. wide and cut to lengths not over 48 in. Must be free from excessive rust, dirt or grease.

(*k*) *High Silicon Scrap.* High silicon billet, bloom, bar crops, plate crops or sheet bar crops, not over .04 per cent phosphorus or sulphur, not less than 2.00 per cent or over 4.50 per cent silicon, free from other alloys, not less than ¼ in. thick, not over 18 in. wide and 36 in. long, and no piece to weigh less than 10 lbs. or more than 500 lbs. To be free from needle and sliver stock. Must be new material and free from excessive rust.

(*l*) *High Nickel Scrap.* Nickel steel billet, bloom, bar crops, or other shapes of similar section and equal grade, not over .04 per cent phosphorus or sulphur, between 3.00 per cent and 3.50 per cent nickel (lower or higher in nickel content to be duly considered), free from other alloys. Not less than 2 in. square or diameter, not over 18 in. wide and cut to lengths suitable for charging boxes of buyers, and no piece to weigh less than 25 lbs. Must be clean material.

(*m*) *No. 1 Chrome Nickel Scrap.* Chrome nickel steel billet, bloom, bar crop, or other shapes of similar section and equal grade, not over .04 per cent phosphorus or sulphur, between 3.00 per cent and 3.50 per cent nickel (lower or higher nickel content to be duly considered), not over .50 per cent chrome, free from other alloys. Not less than 2 in. square or diameter, not over 18 in. wide and cut to length suitable for buyers' charging boxes and no piece to weigh less than 25 lbs. Must be clean material.

(*n*) *No. 2 Chrome Nickel Scrap.* Chrome nickel steel billet, bloom, bar crops, or other shapes of similar section and equal grade, not over .04 per cent phosphorus or sulphur, between 1.50 per cent and 2.50 per cent nickel (lower or higher nickel content to be duly considered), between .50 per cent and 1.00 per cent chrome, free from other alloys. Not less than 2 in. square or diameter, not over 18 in. wide and cut to lengths suitable for buyers' charging boxes, and no piece to weigh less than 25 lbs. Must be clean material.

(*o*) *Light Chrome Nickel Scrap.* Nickel or chrome nickel steel of the analyses and descriptions as shown for grades "L," "M," and "N" except it may be lighter and of miscellaneous shapes. To be fully described at time of sale and purchase.

(*p*) *Special Chrome Nickel Scrap.* Nickel or chrome nickel steel of the analyses and descriptions as shown for grades "L," "M" and "N" except the phosphorus and sulphur may go up to, but not over, .05 per cent. To be fully described at time of sale and purchase.

(*q*) *Nickel Steel Turnings.* Heavy short first cut turnings from nickel steel forgings. Nickel and chrome content to be specified on each indivdual sale. To weigh not less than 75 lbs. per cu. ft. To be free from dirt and other foreign materials.

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Specifications for Scrap for Use in Electric Furnaces.

Alloy steel scrap may be excluded from these specifications by mutual agreement between buyer and seller.

(*a*) *Punchings and Clippings.* Open hearth steel punchings and clippings, ¼ in. and heavier, 4 in. and under in length. Not over .04 per cent in phosphorus or sulphur, and suitable for shovel charging. Must be clean and free from galvanized or coated stock, dirt and excessive rust or corrosion.

(*b*) *Guaranteed Heavy Scrap.* Open hearth steel plates, structural shapes, crop ends, shearings, broken steel tires, knuckles, tool steel and spring steel. To be not less than ¼ in. thick, other dimensions subject to agreement. Not over .04 per cent in phosphorus or sulphur, clean, free from excessive rust and corrosion and contain no foreign material.

(*c*) *Unguaranteed Scrap.* Steel plate, shearings, nut and bolt punchings, short rails and other similar material, not less than ¼ in. in thickness, and not over 12 in. in width or length. Not guaranteed under .04 per cent phosphorus or sulphur. To be suitable for hand charging. Must be free from galvanized and coated stock, foreign material, and excessive rust or corrosion.

(*d*) *Guaranteed Axle Turnings.* Heavy steel or iron axle or forge turnings, guaranteed not over .04 per cent in phosphorus or sulphur. To contain no foreign material and must be clean and free from excessive rust and corrosion.

To weigh not less than 75 lbs. per cubic foot.

(*e*) *Unguaranteed Turnings.* Short, heavy shoveling steel or iron turnings or rail chips, not guaranteed under .04 per cent in phosphorus or sulphur. To contain no foreign material and must be free from excessive rust or corrosion.

To weigh not less than 75 lbs. per cubic foot.

Specifications for Scrap for Use in Gray Iron Foundry Practice.

(*a*) *No. 1 Machinery Cupola Scrap.* Clean machinery cast iron scrap. Must be cupola size, not over 30 in. in any dimension and no piece to weigh over 150 lbs.

(*b*) *No. 1 Machinery Breakable Scrap.* Clean machinery cast iron scrap, weighing over 150 lbs. and which can be easily broken by an ordinary drop into cupola size.

(*c*) *No. 1 Standard Cupola Scrap.* Clean cast iron scrap, such as columns, pipes, plates, and castings of miscellaneous nature, but free from stove plate and agricultural scrap. Must be cupola size, not over 30 in. in any dimension, and no piece to weigh over 150 lbs. Must be free from foreign material.

(*d*) *No. 1 Standard Breakable Scrap.* Clean cast iron scrap, such as columns, pipes, plates, and castings of miscellaneous nature, weighing over 150 lbs. and which can be broken by an ordinary drop into cupola size.

(*e*) *Burnt Cast Scrap.* Burnt cast iron scrap, such as grate bars, annealing boxes, stove parts, and any miscellaneous burnt scrap. Must be cupola size, not over 36 in. in any dimension, and no piece to weigh over 200 lbs.

A. R. A. classification No. 18 will be acceptable.

(*f*) *Stove Plate Scrap.* Clean cast iron stove plate. Must be free from malleable and steel parts, window weights, plow points, grates, burnt iron, etc.

(*g*) *Agricultural Scrap.* Cast iron parts of agricultural machinery, including plow points. Must be free from steel, malleable and full chilled iron.

(*h*) *Cast Iron Wheels.* Clean, chilled cast iron car wheels, conforming to A. R. A. specifications.

A. R. A. classification No. 54 will be acceptable.

(*i*) *Brake Shoes.* Driving and car brake shoes of all types, except composition filled shoes.

A. R. A. classification No. 19 will be acceptable.

(*j*) *No. 1 Radiator Scrap.* Broken radiator castings, with all steel, malleable and other parts removed. Must be free from excessive scale, rust and corrosion.

(*k*) *No. 2 Radiator Scrap.* Unbroken radiator castings, with all steel, malleable, and other parts removed. Must be free from excessive scale, rust and corrosion.

(*l*) *No. 1 Malleable Scrap, Air Furnace Practice.* Malleable parts of automobiles, railroad cars and miscellaneous malleable castings. Must have undergone the annealing process. Must be free from steel and cast iron parts.

A. R. A. classification No. 30 will be acceptable.

(*m*) *No. 2 Malleable Scrap, Air Furnace Practice.* Malleable parts of agricultural implements, and other miscellaneous malleable castings. Must have undergone the annealing process. Must be free from steel and cast iron parts.

(*n*) *Cupola Malleable Scrap.* Malleable parts of agricultural implements, automobiles, railroad cars and similar miscellaneous malleable castings, suitable for cupola charging. Not over 36 in. in any dimension or 150 lbs. in weight. Must have undergone the annealng process. Must be free from steel and cast iron parts.

Specifications for Scrap for Use in Bessemer Converters.

(*a*) *Mild Steel Converter Scrap.* Mild open hearth steel scrap, such as structural shapes, rolling mill crop ends, forgings and forge crop ends. No piece to weigh over 150 lbs. or less than 10 lbs., not under ⅜ in. section, and must not exceed 24 in. in any one dimension. Must be free from excessive rust or corrosion.

(*b*) *High Carbon Steel Converter Scrap.* High carbon or hard steel scrap, such as steel rails and material of similar analysis. No piece to weigh over 150 lbs. or less than 10 lbs., and must not exceed 24 in. in any one dimension. Must be free from excessive rust or corrosion.

(*c*) *Steel Spring Scrap.* Coil and leaf springs, made from stock ⅜ in. in thickness or heavier. Elliptical springs must be cut apart, and must not exceed 24 in. in length. Must be free from plates, and from excessive rust or corrosion.

Miscellaneous Scrap Specifications.

(*a*) *Crucible Steel Scrap.* Boiler and structural steel punchings, under .04 per cent in phosphorus or sulphur. This is a basic classification for crucible steel scrap. In the event any other material is specified, no piece shall exceed 5 in. in width or 8 in. in length.

In the event that small soft steel castings are specified as crucible scrap, the weight shall not exceed 10 lbs. per piece.

Must be free from tinned and galvanized stock, malleable and cast iron and all foreign metals. Must be clean, and free from dirt and excessive rust or corrosion.

(*b*) *Re-rolling Rails.* Standard section steel tee rails, 50 lbs. per yard and heavier, 10 feet long and over. Suitable for re-rolling. Free from bent and twisted rails, frog, switch and guard rails with split heads and broken flanges.

(*c*) *Chemical Borings.* Clean, fine, dry cast iron borings free from oil and grease. Shall contain no lump or rusty stock, and be free from other metals.

The personnel of the National Conference on Iron and Steel Scrap Specifications at the Bureau of Standards, Washington, D. C., January 12, 1925, included the following:

Bureau of Standards—George K. Burgess, Director; H. W. Gillett, Chief, Division of Metallurgy; John R. Freeman, Jr., Division of Metallurgy.

Federal Specifications Board, Metals Committee—J. E. Munroe, Lt. Col., U. S. Army Ordnance Department; H. A. Stacy.

U. S. Navy Department—Lt. C. W. Shaeffer, Bureau of Supplies and Accounts; W. Adams, Bureau of Supplies and Accounts; A. P. Harclerode, Bureau of Classification and Reclamation of Scrap.

U. S. Naval Gun Factory—P. E. McKinney, W. H White.

American Electric Railway Association—E. S. Pardoe, Capital Traction Company, Washington, D. C.

American Railway Association—H. C. Stevens, General Storekeeper, Wabash Railroad, St. Louis, Mo.; C. B. Tobey, General Storekeeper, Lehigh Valley Railroad, Wilkes-Barre, Pa.

American Society for Steel Treating—L. H. Fawcett, Washington, D. C.

National Association of Purchasing Agents—G. C. McClure, Chairman, Iron and Steel Committee, American Rolling Mill Company, Middletown, Ohio; W. W. MacMillen, National Malleable & Steel Castings Company, Cleveland, Ohio; H. C. Wickline, Union Steel Casting Company, Pittsburgh, Pa.; W. L. Chandler, Secretary, New York City; Russell Forbes, Assistant Secretary, New York City.

National Association of Sheet and Tin Plate Manufacturers—G. C. McClure, American Rolling Mill Company, Middletown, Ohio.

National Association of Waste Material Dealers—H. R. DeGroat, A. M. Wood & Co., Philadelphia, Pa.

Steel Founders Society of America—H. C. Wickline, Union Steel Casting Company, Pittsburgh, Pa.

H. L. Batteiger, Agnew Batteiger & Company, Philadelphia, Pa.

J. V. H. Bishop, Bishop & Company, Philadelphia, Pa.

G. H. Lange, The Phoenix Iron Company, Philadelphia, Pa.

H. H. Moffitt, Agnew Batteiger & Company, Philadelphia, Pa.

G. A. Pedrick, Penn Seaboard Steel Corporation, Philadelphia, Pa.

G. W. Starr, United Alloy Steel Corporation, Canton, Ohio.

Trade Publications.

Blast Furnace and Steel Plant—F. J. Crolius, editor, Pittsburgh, Pa.

Daily Metal Reporter and Waste Trade Journal—Leon Cohen, Washington, D. C.

The Iron Age—L. W. Moffett, Washington, D. C.

Iron Trade Review, Foundry, and Daily Metal Trade—F. B. Pletcher, Washington, D. C.

Institute of Metals

The Annual General Meeting of the Institute of Metals will be held at the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.1, on Wednesday and Thursday, March 11 and 12, commencing each day at 10 a.m. Twelve communications are due for presentation at the meeting. The annual dinner will take place at the Trocadero Restaurant on Wednesday, March 11, at 7 p.m. Amongst those who have accepted the Council's invitation to be present at the dinner are the Rt. Hon. Neville Chamberlain, P.C., M.P., (Minister of Health); the Rt. Hon. Lord Morris, P.C., K.C.M.G., LL.D., K.C., (vice chairman, Imperial Mineral Resources Bureau), and the presidents of many kindred societies. Ladies will be present, Mrs. Neville Chamberlain accompanying the Minister of Health. Separate tables—seating seven persons—will be provided, thus facilitating the arrangement of parties. Tickets, price 15/s. each, can now be obtained, and tables reserved, on application being made to the secretary, 14 Members Mansions, S.W.1.

There has just been issued the thirty-second volume of the Journal of the Institute of Metals—a book of 832 pages. It includes, in addition to 13 communications presented at the autumn meeting, the May lecture, the autumn lecture, the seventh report to the Corrosion Research Committee, and an abstracts section that is exceptionally full and informative.

Members and students elected as a result of the next ballot—which closes at noon on February 25th—will be entitled to membership until June 30, 1926. This means that a member's first subscription will cover considerably more than the usual period of 12 months. In addition, new members and students will be entitled to receive an extra copy of the Journal—making three volumes in all. Membership particulars can be obtained from the secretary, Mr. G. Shaw Scott, M.Sc., 36 Victoria Street, Westminster, S.W.1.

Current Literature of Ferrous Metallurgy

(Continued from page 114.)

Verschleissversuche mit kugellager-chromstahl. H. Redenz. *Stahl u. Eisen*, v. 44, Dec. 18, 1924, p. 1703-1708.

Warmebehandlung bei der einsatzhärtung. F. Brüsewitz. *Stahl u. Eisen*, v. 44, Dec. 18, 1924, p. 1697-1698.
With micrographs showing effects of case-hardening.

Where steel went in nineteen twenty-four. *Iron Age*, v. 115, Jan. 1, 1925, p. 4-8.
Consumption of steel by various industries.

Wissenschaftliche prüfung und erforschung der edelstähle. F. Sommer and F. Rapatz. *Stahl u. Eisen*, v. 44, Dec. 18, 1924, p. 1739-1743.

SHEET AND TIN PLATE

Recuperation and Recuperators

A Discussion of the Various Types of Heat Recovery Devices Now in Service

By CHARLES LONGENECKER*

THE statement has been made that the American business man devotes his energy principally to devising means for making money rather than for saving that already on hand. The American engineer works along analogous lines as regards heat. The generation of heat is stressed to a far greater extent than the reclamation of that already created. A perusal of the files of the patent office reveals the correctness of this latter statement. Thousands of patent applications covering various methods for burning coal, oil and gas are yearly recorded while in the same period no more than a hundred applications cover heat saving devices. The most advanced methods of burning fuels are found in America while the Europeans have excelled in heat reclaiming methods. The reason for this is obvious when a comparison is made between the fuel resources of the two continents.

Practically all engineers favor recuperation. There are some heating operations carried on at a low temperature, with a consequent low fuel consumption, which do not justify recuperation as the saving in fuel does not warrant the investment but on most furnaces the heat reclaimed returns a high interest on the expenditure.

Like many other inventions the early history of recuperation is clouded by the claims and counterclaims of several inventors. Standing out prominently among the claimants is the work of Neilson who applied his cast iron recuperator pipes to the heating of air by the gases coming from a blast furnace. He was able to secure a preheat of 300 deg. F. to 400 deg. F. Since this time, 1847, thousands of furnaces have been constructed embodying in some form means for saving fuel by preheating the air for combustion. Most of these furnaces have employed pipes of cast iron as the circulating medium for the air. Very frequently these pipes were placed in the brick connection between the heating chamber and the chimney and not infrequently in the chimney itself. In nine cases out of ten the results were unsatisfactory for a variety of causes but generally because the pipes burned away. Other causes of failure were poor design of the equipment as a whole. The velocity of the air was either too rapid or too slow. This latter cause of failure is the predominant one today. The majority of recuperators have been designed by inexperienced persons whose dominating idea has been heat transfer but who have not had the experience necessary to enable them to determine the areas, etc., necessary for the proper air and gas passages. The result was that in some cases there was no heat recuperation worthy of consideration indicating too high air velocity while in other cases the air was too hot which indicated a too slow movement of the air and foretold the burning out of pipes.

The amount of preheat which can be obtained depends on several factors.

First: The temperature of the waste gases.

Second: The volume of the waste gases in cubic feet.

3rd: The design and construction of the recuperator.

Knowing the above the percentage of heat which will be returned as sensible heat in the air can be determined. The volume of the waste gases is obtained from the quantity of fuel burned per hour.

As in practically every case of furnace design, each installation must be treated individually for rarely are the conditions the same and in every case the exact operating features must be known. Thus before designing a recuperator the following information must be obtained:

The kind of fuel to be burned.
Analysis and heat content of fuel.
Quantity of product heated per hour.
Temperature of product and waste gases.
Characteristics of furnace as to material heated, etc.

There is a misunderstanding among some persons as to the meaning of recuperation as compared to regeneration. Where recuperation is practiced the waste gas and air travel continuously in separate ducts and the heat transfer is through some medium from the gas to the air. In regeneration the heat transfer is not continuous between the waste gas and air and transfer is effected by the alternate heating and cooling of a body of brick. This difference in the two systems is that in recuperation the temperature in the furnace remained constant while where regeneration is employed the temperature of the incoming air, and hence the furnace, varies. Regeneration is confined to furnaces in which the temperature is comparatively high and the dimensions large. Recuperation has a much more extensive field as it can be applied to practically any class of furnace excepting those carrying a very low temperature as previously mentioned. Recuperation is to be preferred to regeneration as a method of extracting heat from waste gas and returning this heat to the furnace considering the matter from a thermal standpoint.

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*Special Engineer, Combustion Engineering Company, Pittsburgh, Pa.

Recuperators can be classified under various heads depending on the material used in construction, the manner in which the air and waste gases are carried through the recuperator and the means employed for causing the air to pass through the ducts.

For comparatively low temperatures metal recuperator pipes are acceptable but their use is confined mostly to small units. In large units metal tubes are not installed to any considerable extent.

In practice it has not been possible to apply metal recuperators to high temperature furnaces due to the inability to secure materials which will withstand the severe conditions imposed by such furnaces.

Recuperators made of fire brick tile will withstand high temperatures and when correctly designed and properly installed will give excellent service. The most important feature is not only the form of the tile which make up the recuperator but the composition of the clay from which the tile are made. Highly silicious clays have a high coefficient of expansion and hence these clays must not constitute too high a percentage in the mixture. In the actual construction of the recuperator the tile should be layed so that all joints are sealed as far as possible. By staggering the tile both horizontally and vertically the joints between tiles will be sealed by those adjoining. This method of placing the tile has given very good results and those furnaces which have been installed and in which this construction has been followed are operating very successfully.

In any form of recuperator, whether constructed of metal or brick tile, it is necessary that the passage-ways for the air, from the point at which the air enters to the burner, be kept tight. The same applies to the passage-ways for the products of combustion. In many of the recuperators built in the past this has not been accomplished. The fault has been not only with the form of the tile but in the design and in the "laying up" of the elements. A large majority of the recuperators have been designed by inexperienced engineers and poor results are directly traceable to this cause. This class of engineering is highly specialized and the information requisite for successful applications is obtained only after years of experience.

There are several types of recuperators based on the manner in which the air is directed through the passage ways. The air can be drawn or induced. In this system a fan, or other means of creating a suction, draws the air into the tile and then discharges it to the burners.

A second type depends on the draft created by the air as it is heated and rises through vertical passages.

The third type distributes the air through the recuperator and employs for this purpose a fan which discharges the air at a very low pressure into the air passages. This method assures high recuperator efficiency and uniform heating of the tile. The air pressure is not great enough to cause any excessive pressure in the passageways.

By recuperation from 40 per cent to 6 per cent of the heat in the waste gases can be recovered.

E. J. Kulas President of Otis Steel Company

It was entirely natural that E. J. Kulas should ultimately become the head of a large steel company.

In assuming the executive responsibilities of the Otis Steel Company, Mr. Kulas carries with him the definite background of a large steel consumer; as a huge buyer of steel in various forms, no one knows better the needs of the market.

E. J. Kulas

His association with and control of such concerns as National Electric Lamp Company, later to become an integral part of General Electric Company, Peerless Motor Car Company, Federal Nut & Bolt Company, and later Parish & Bingham Company, probably the greatest producer of automobile frames, etc., has eminently fitted him to carry on and expand upon the foundations already so carefully laid Under his direction, Otis Steel should continue to grow in influence, especially in the important field of automobile steels.

General Electric Welding Manual

A 127-page volume, well bound in cloth, is the Arc Welding and Cutting Manual recently issued by the General Electric Company. This has been given the designation Y-2007 and was issued "to acquaint the uniformed in a general way with some of the applications of arc welding, and to provide a simple and logical method by which one may acquire a certain familiarity with the manipulation of the electric welding arc and its characteristics."

The volume is profusely illustrated with photographs, diagrams and charts explanatory of the text. It is divided into three parts, the first devoted to general information on arc welding, the second to a training course for operators, and the third giving a number of applications of arc welding. The manual should prove very valuable in practically all industries and trades. It is being distributed at a nominal price.

Simplification of Sheet Steel

Estimated Saving of More than $2,500,000 Annually Indicated by Sweeping Reduction in Variety

SIMPLIFICATION of variety of sheet steel, the third of the eleven principal products of the steel group, foreshadows a saving of more than $2,500,000 annually to the industry, according to an estimate furnished to the Division of Simplified Practice, Department of Commerce, by Walter C. Carroll, vice president of the Inland Steel Company, Chicago, who was a leading figure in the movement to reduce the variety of sheet steel sizes.

In the forthcoming booklet in the Division of Simplified Practice "Elimination of Waste" series, dealing with this simplification, it is pointed out by Mr. Carroll that 35 manufacturing companies having 686 mills are affected. The production involved is 5,000,000 net tons annually.

Sheet steel, it is pointed out, has a widely varied demand, ranging from the automobile industry, which consumes 37 per cent, down to the casket and vault industry, in which the demand is less than one per cent. The distribution of sheet steel by jobbers is some 13 per cent of the production, ranking second only to the automobile industry.

Eighty-five per cent of the demand, Mr. Carroll indicates, was for 15 per cent of the sizes manufactured before the simplification program was undertaken. In the field of one pass cold rolled and box annealed steel, 72 per cent of the demand was in 43 of 434 numbers made. In blue annealed sheets, 70 per cent of the demand was in 52 of 523 numbers made. In galvanized sheets 71 per cent was for 110 of 673 items made, while in galvanized roofing there was 97 per cent of the demand for 38 of the 142 varieties made. Eighty per cent of the demand in painted roofing was for six of the 47 numbers made.

Warehousing of the 1819 varieties made has been a huge expense for the distributor, it is pointed out; and if the sizes had been reduced by but 50 per cent the saving would have been $2,500,000 annually.

Annual Banquet of Engineers Society

This Important Gathering Filled the William Penn Ballroom with More Than 1,000 Engineers and Executives

THE annual meeting of the Engineer's Society of Western Pennsylvania has become a recognized Mecca to which all eyes turn. This year was no exception, and on January 26 Pittsburgh was the executive center of the steel and power world.

Every year brings added lustre to a sequence of brilliant gatherings. In 1924, the society introduced Mr. Elisha Lee in a memorable address, prefaced by Mr. Arthur Thompson in the role of toastmaster.

This year, two exceptional speakers were introduced by George Nielson, vice president of Braeburn Steel, who acted as toastmaster.

The first Mr. M. S. Sloan, president of the Brooklyn Edison Company brought home to his audience many of whom were well-known central station men the importance and responsibilities involved in the operation of the great utility properties.

Following this forceful address Mr. Edward Hilton Young initiated his audience into the mysteries of international diplomacy.

Mr. Young is a member of the present British Parliament; an authority on International finance; he was financial secretary of the British treasury 1921-23, and financial adviser to the Polish Government in 1924. He is a lawyer by profession; has served as attorney general, and was for a number of years technical editor of the London Morning Post. He is an author of repute, and during the World War served as a naval officer on the "Vindictive" in the attack on Zeebrugge.

To describe Mr. Young's speech would be difficult; rather than a speech, was it an intimate picture of world important reminisicences—thrilling in their directness. At its conclusion every attentive listener was conscious that he was better equipt to understand the supreme importance of permanent co-operation between our two great English speaking nationalities.

Sheet and Tube Will Build New Bar Mill

The directors of the Youngstown Sheet and Tube Company, yesterday appropriated $2,000,000 for mill extensions in the Chicago district. The appropriation is the forerunner of $6,000,000 more to be gotten under way this year. "There will not be any financing connection with the extensions," declared President James A. Campbell, indicating they will be financed from earnings.

The company has awarded contracts for a bar mill to cost about $2,000,000, to roll sheet bars, and intermediate sizes of skelp.

The Morgan Engineering Company of Worcester, Mass., will build the barmill, with the United Engineering and Foundry Company, Pittsburgh, supplying heavier parts. It is expected the unit will be ready for operation by the end of 1925.

The mill authorized will supply semi-finished steel for sheet and tin mills to be installed at Chicago, which will absorb balance of the $8,000,000 expenditure this year.

President Campbell stated demand is improving for lapweld pipe and oil well tubular products, and that weakness in the sheet market is most noticeable in full finished lines. He said the spring outlook for finished steel is favorable.

CURRENT REVIEW

Making Pig Iron from Utah Ore[*]

By GEORGE J. YOUNG[†]

THE Columbia Steel Corporation's pig iron plant at Provo, Utah, derives its raw materials, coal, iron ore and limestone, from deposits in Utah. The iron mines[‡] are in the Iron Springs district, 21 miles south of Lund on the Salt Lake & Los Angeles division of the Union Pacific Railroad. The coal mine operated by the company is near Sunnyside and is served by a branch line from the Denver & Rio Grande Railroad. A branch line has also been constructed to the iron mines by the Union Pacific. Limestone is derived from local sources near Provo. The iron mine has been opened by an adit and the ore is mined by a series of surface mill holes. Ore is graded into two classes and is discharged from the railroad cars into the charge bins, or stockpiled, at the Provo plant. Coal is crushed by toothed rolls to 1½-in. at the mine and sent to the coal preparation plant or stockpiled.

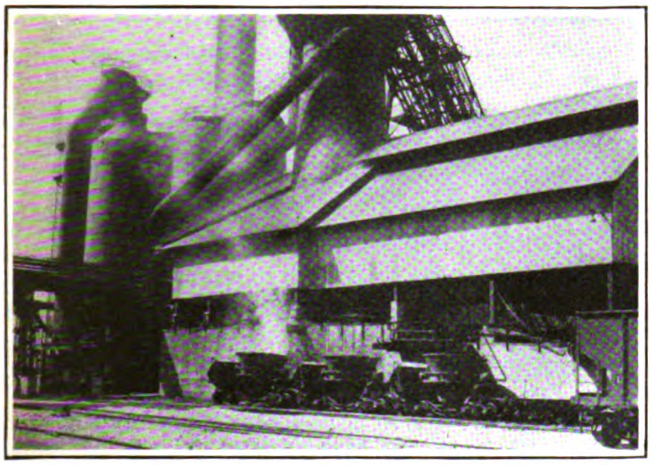

FIG. 1.—*Blast-furnace slag is handled in ladle cars, three of which are shown here.*

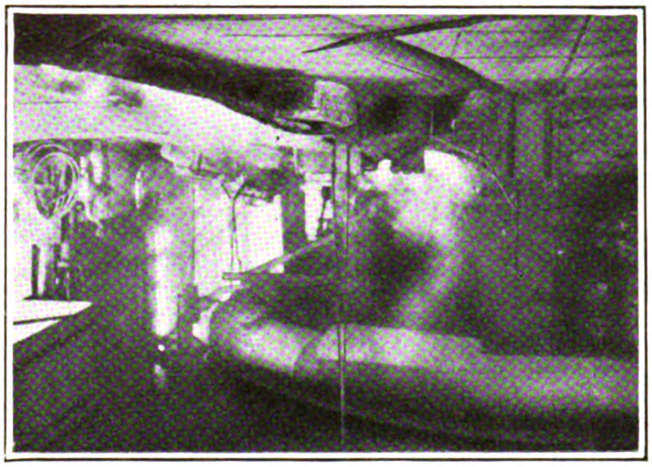

FIG. 3.—*Tapping the 350-ton blast furnace.*

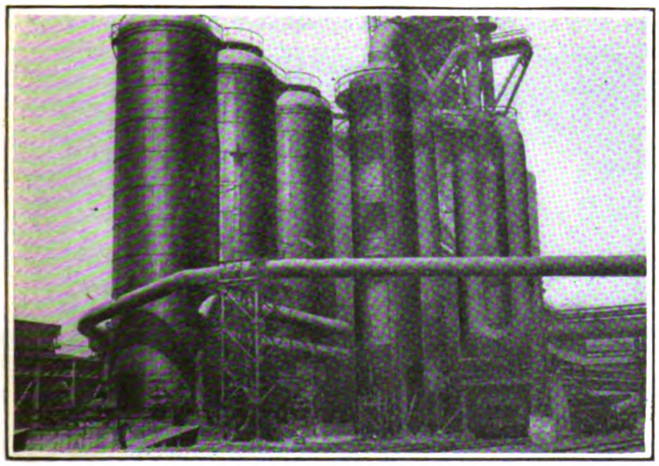

FIG. 2.—*Hot blast stoves and scrubbers. The furnace is provided with four stoves, as customary.*

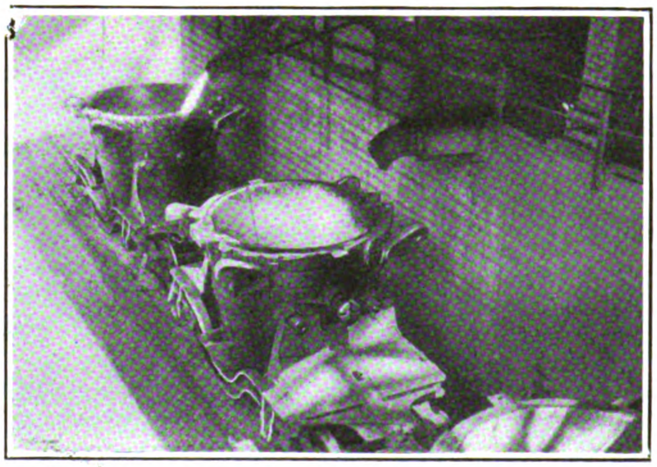

FIG. 4.—*Molten iron is handled in ladle cars, which are hauled by wire rope to the casting plant.*

The plant at Provo is three miles south of the town on a site that slopes gently to Utah Lake. Freyn, Bassert & Company, of Chicago, designed the installation, which was erected by the engineers of the Columbia Steel Corporation. It was completed early in 1924, and has since been in operation.

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[*] Reprinted from Engineering and Mining Journal-Press.

[†] Associate Editor.

[‡] See "Iron Ore Deposits of Southern Utah," by D. P. Rohlfing, Mining Journal-Press, Vol. 115, p. 716; also "Pacific Coast and Its Significance for Western Iron Mining," by E. Y. Dougherty, Mining Journal-Press, Vol. 117, p. 447.

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The equipment consists of a single blast furnace, coal preparation and conveying machinery, a by-product coking plant, power plant, shops and laboratories, and charging bins. The plant is modern in all respects and complete within the limits of its objectives.

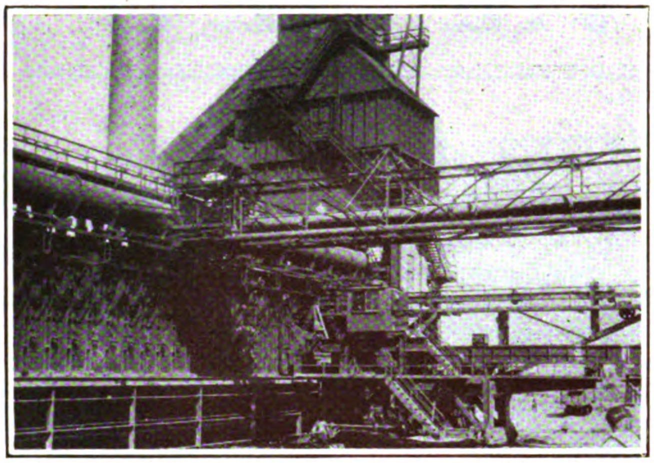

FIG. 5.—*This battery includes thirty-three Koppers coke ovens with an accessory by-product plant.*

Steel and concrete have been largely used in construction. Conveyors and electric locomotives are used for transportation, and the handling of materials involves a minimum of labor.

The blast furnace is rated at 350 tons of pig iron per day. It is 15 ft. in diameter, bosh diameter 19 ft., and height 83 ft. Eight tuyeres distribute the air at the hearth. Skips operated by an automatic Otis hoist are used for charging. Upper and lower bells are operated by air cylinders. The furnace is completely equipped with recording indicators for height of charge, blast pressure and temperature. Four hot blast stoves with accessory dust catchers and washers handle the gaseous products. The water from the gas washers is laundered in a Dorr thickener for the removal of solids which are high in iron and are returned to the furnace. The gas is piped to the steam generating plant. The iron and slag are handled in ladle cars. The ladle cars carrying the molten iron are hauled by wire rope to the casting plant. The casting plant consists of two lines of molds which are arranged on the pan-conveyor principle, receiving the iron from spouts and discharging the pig iron after passing under cooling sprays into steel cars for shipment. A 50-ton Cleveland traveling crane serves the casting shed.

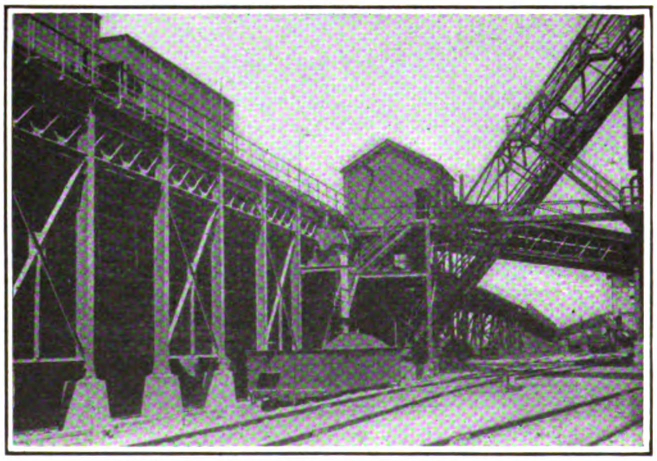

FIG. 8.—*Ore- and coke-charging bins.*

Coal preparation is effected by a hammer pulverizer which reduces 75 per cent of the coal to ⅛-in. size. A conveyor system discharges the coal into hoppers above the coking ovens which are used to load the lorries. The battery of coking ovens consists of 33 Koppers ovens with accessory by-product plant. Benzol, coal tar, and ammonium sulphate are made, and the clean gas is used for heating the ovens. The ovens are 14 in. wide.

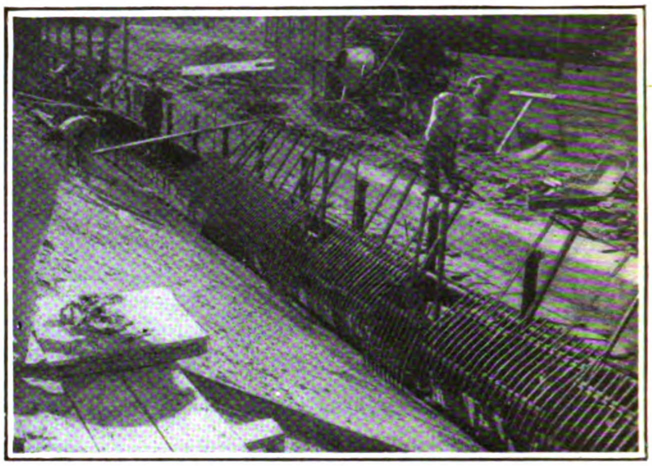

FIG. 6.—*The coke-cooling floor slopes to and discharges onto a 30-in. belt conveyor.*

The coke is discharged by a pusher into a special car, which is moved by a wire-rope haul to the quenching tower, where the coke is drenched. The car is returned and the contents are discharged upon the cooling floor, which slopes to and discharges upon a 30-in. belt conveyor. Gates control the discharge to the belt. The coke is conveyed to the screen house. Three sizes are made: furnace coke, which is conveyed to the charging bins; domestic coke, which is received into cars for shipment, and breeze, which is loaded into cars and used at the power plant. A Koppers rotary grizzly and a Mitchell screen are used for sizing. The benzol product is sold locally, the tar is sold to the Barrett Company, which has a small plant near by, and there is a steady demand for the ammonium sulphate, which is shipped to Hawaii.

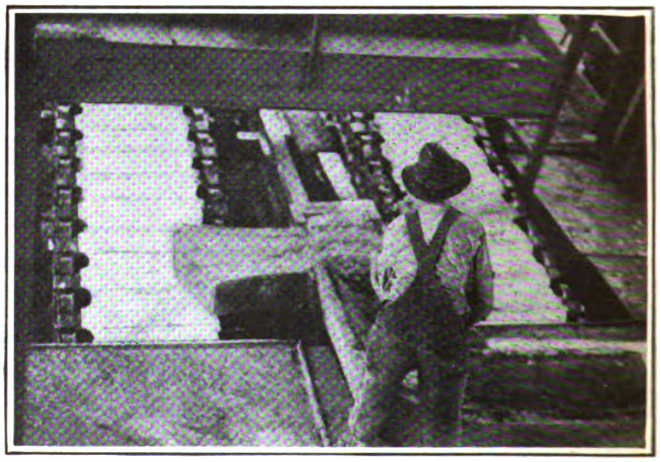

FIG. 7.—*Casting pig iron. There are two lines of molds arranged on the pan conveyor principle.*

The boiler plant is equipped with five 617-hp. boilers of the modified Heine type. Blast-furnace gas is used for fuel. Coke-oven gas is piped to the boilers and used to compensate for any deficiency. Excess gas is wasted. The boiler plant and power house are in close proximity and both are near the blast furnace.

The power equipment is housed in a brick and steel building which is served by a 20-ton Cleveland traveling crane. Two General Electric generators, driven by Curtis turbines, each of 1,500-kw. capacity, supply a.c. for the plant. Two Ingersoll-Rand rotary blowers, each of variable capacity from 30,000 to 50,000 cu. ft. of air at 18 lb. pressure, supply the air for the blast furnace. They are driven by steam turbines. In addition, two rotary converters supply d.c. at 250 volts for crane, trolley, and miscellaneous service. Condensing equipment for the steam turbines is placed on a lower floor of the power house. Additional power is supplied by the Utah Power Company. The plant is in charge of L. F. Rains.

Foreign Digest

By Albert P. Sachs*

The latest number of the Transactions of the Faraday Society (British) contains a general discussion of fluxes and slags in metal melting and working. The papers presented include some relating to the iron and steel industry. B. Bogitch writes on the Sulphurizing and Desulphurizing of Metals by Basic Slags and Fluxes. Sulphurizing occurs in the formation of mattes, desulphurizing in purifying metals, notably in the treatment of steel in the electric furnace. Special fluxes have been developed of low viscosity and high solvent power for sulphur and sulphides to strip the molten metal of its sulphur content.

Prof. Haigh contributed a paper on Slag Inclusions in Welding and Soldering in which he discussed slag inclusions in relation to fatigue. Slag inclusions are particularly important in electric (arc) welding. He showed an important relationship existing between the fatigue limit and the ultimate stress.

Ogden in "Fluxing Problems in Welding of Mild Steel with the Metallic Arc" shows that a suitable flux gives a weld of superior mechanical properties.

The Zeitschrift für Instrumentenkunde considers the problem of the thermal expansion of soft and hardened steel from 200 deg. to 150 deg. C. For the soft steels the average value at 20 deg. C. is 11.2×10^{-6} and for the same steels when hardened 12.7×10^{-6}. In all cases the rate of thermal expansion increases with rising temperature. For a soft steel in liquid air the value is 6.3×10^{-6} rising to 12.9×10^{-6} at 150 deg. C., while for a hardened steel the corresponding values are 7.1×10^{-6} and 14.6×10^{-6}. Increasing manganese content increases the rate of thermal expansion and the addition of copper still further augments the increase. The commonly accepted values of 10.5×10^{-6} for soft steels and 11.0 to 11.5×10^{-6} for hard steels are too much in error to be used for calibrating instruments.

Stainless steel may yet find important uses for chemical equipment. The Chemical Trade Journal (British) brings out the fact that a cheaper product is foreshadowed by the Hamilton-Evans processes with resultant new uses. Mild stainless steel resists scaling remarkably to 825 deg. C. (1517 deg. F.), and retains its strength at high temperatures to a much greater degree than does ordinary mild steel. Methods of pickling, sand-blasting and etching are described.

The Zeitschrift für Metallkunde gives the heat conductivity of technically important metals and alloys. The values obtained by various investigators are tabulated, critically examined, and the most probable values with the probable limits of error given. The metals are aluminum, lead, iron, copper, nickel, silver, bismuth, tin, zinc and the technically important alloys of aluminum, iron, copper and bismuth.

Two articles are published on stellite and similar alloys such as akrite. These are essentially non-ferrous alloys, although stellite may have up to 5 per cent iron. Stellite is 40-55 per cent cobalt, 15-33 per cent chromium, 10-17 per cent tungsten, about 2 per cent carbon, may contain up to 5 per cent iron, and sometimes molybdenum, silicon and manganese. It is a high speed cutting metal. If about 4 per cent nickel is added and cobalt correspondingly decreased we have akrite which is less brittle and even more effective as a high speed metal.

C. Benedicks in the Comptes Rendus de l'Academie des Sciences describes a method for determining the density of iron and other high melting metals in the liquid state.

Stahl und Eisen contains an article on the thickness of the zinc coating on galvanized iron. The thickness of the zinc coat in the usual dipping process is the chief item in the cost of galvanizing. The thickness depends on the intensity of the interaction between iron and zinc (which depends partly on the temperature) and on the viscosity of the bath. The thinnest and most satisfactory coating is made from a zinc bath containing 0.5 per cent aluminum and 1.0 per cent tin, under which conditions the zinc coat taken up should not exceed 500-600 gm. per sq. m. (1 2/3 to 2 ounces per sq. ft.).

The Journal of the Society of Chemical Industry (London) contains "A Critical Study of the Published Results of Tests of Water-Gas Plant," which should have considerable interest for those who have attempted to study blast furnace gas and to arrive at accurate heat balances. The study is accompanied by numerous tables, graphs, and run records, and every aspect of the problem is critically examined.

An address before the Liverpool section of the Society of Chemical Industry discusses the metals used in making alloy steels. It summarizes our knowledge of the effect of the various alloying metals.

German patent 401779, class 48a, to Dr. Erik Liebreich of Berlin-Halensee is for a method of protecting the inner walls of iron vessels or containers subjected to changing temperatures against rust. It consists in coating the iron with films of rust-proof alloys of iron containing chromium, molybdenum, uranium, manganese, cobalt and nickel by electrolytic deposition. Very thin electrolytic films make the iron completely rust resistant and remain completely coherent during temperature changes. Good results were obtained with chromium-iron films. As electrolyte solutions were used containing salts of such metals as were desired for alloy films. The solutions must be quite concentrated to give good results, as anodes iron wire or rods were used. This is the simplest method to obtain cathodic iron deposits of iron alloys.

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*Technical Director, Universal Trade Press Syndicate.

Opportunity to Purchase Preferred Stock Again Offered Bethlehem Employees

In response to numerous requests from employees the Bethlehem Steel Corporation, last year, inaugurated the Employees Saving and Stock Ownership Plan, providing an opportunity for the employees to acquire shares of its 7 per cent Cumulative Preferred Stock upon easy terms of payment. Because of the interest shown in the plan the management has provided an opportunity again this year for the employees to buy stock under the plan.

In response to the first offering a year ago 19,922 employees applied for a total of 51,034 shares. The total saving by those employees, if continued over the full payment period of 21 months, would have amounted to more than $4,700,000 including he dividends and special benefits accruing under the plan.

Owing to the business depression in the summer of 1924, with consequent reduction of earnings, some employees were obliged to cancel their applications, and their payments were returned with interest at 5 per cent. In view of business conditions the proportion of cancellations was surprisingly small, and the great majority of those who applied last year have continued under the plan in spite of the difficulties experienced.

General Provisions of this Year's Plan.

The second annual offering of 7 per cent cumulative preferred stock under the Saving and Stock Ownership Plan was made beginning February 3, 1925, at a price of $100.00 per share, and applications were accepted from that date until March 3rd. Under the terms of the plan an employee is allowed to apply for one share of stock for each $400.00 of his or her annual earnings. The stock may be paid for in installments to be deducted from earnings at the minimum rate of $4.00 per share per month if paid monthly, or $2.00 per share per pay if paid every two weeks, or $1.00 per share if paid weekly.

Deductions from Pay to Start in April.

The deductions for stock applied for will be made from earnings on each pay day beginning the first pay received in April.

Dividends and Special Benefit Payments.

While interest will be charged at the rate of 5 per cent per year on the unpaid balance of the purchase price of the stock until payment is completed, the purchasers in the meanwhile will be credited with all dividends declared. In addition, as an incentive to the purchasers to hold the stock while they remain in the employ of the corporation, a special benefit payment will be made in January of each year for five years upon the stock purchased this year and held by the employee, as follows:

1926—$1 per share; 1927—$2 per share; 1928—$3 per share; 1929—$4 per share, and 1930—$5 per share.

Increased Income and Protection.

By acquiring stock in the Corporation the employees automatically become part owners in its business. Furthermore, a plan of this kind gives the employees an opportunity to save money in a way which, if carried on consistently from year to year, will increase their yearly income and provide additional protection against the future.

How Plan Helps Saving.

The rapidity with which savings accumulate under the plan is shown by the accounts of those employees who started saving under the plan last year as illustrated below. The periods for which calculations are shown are—(1) at the end of the first year; (2) at the end of 21 months, which is the time over which deductions at the minimum rate of $4.00 per month per share will be made; and (3) at the end of 5 years when the special benefits will have been completed by the company, after which the employees holding stock will receive the regular dividends as paid.

What an investment in one share will mean at the end of 5 years, that is, at the end of the special benefit period in the 1924 offering. (Purchased at $94.00):

Payroll deductions at $4.00 a month for 21 months (plus 97c. the last month)		$84.97
Add 20 quarterly dividends of $1.75 each	$35.00	
Add 5 special benefit payments	15.00	
	$50.00	
Subtract interest on unpaid balances at rate of 5%	4.22	
Increase on Savings		45.78*
Total accumulation if you have saved all dividends and special benefit payments		$130.75

The amount of $45.78 as shown above (*) is at the average annual rate of more than 10¾ per cent for 5 years. This is without taking into account any possible increase in the market value of the stock above the purchase price.—Bethlehem Review.

Technical Articles

Taking up the postwar slack. How a New England manufacturer, left high and dry by the Armistice with a million square feet of idle floor space, staged a brilliant comeback.

When buying castings—you should know how design affects product; how patterns should be made; how costs are calculated; how foundrymen can be of service and what are the duties of buyer and seller.

Britain experiments with steel house.

Copper conductivity improved.

Melting bronze in electric furnace.

Magnetic chuck aids output. Grinding operations in tool-room simplified by positioning work properly.

Is United States financing German competition?

Heat treating machine parts. Carefully devised system of routing material through the shop enables small hardening department to handle work for a large tool manufacturer.

Sponge iron produced in kilns. Iron ore mixed with crushed coal is reduced to a material of commercial value.

Reducing speed by gear sets.

Train molders in new school.

Distribution not production is problem of today.

Heat treating malleable castings prior to galvanizing.

States insist in handling child labor problems.

Woven fencing cages skull cracker.

Improved distribution pays big dividends to industry.

How many new automobiles in 1925?

Steel caskets are custom made.

Making hard manganese steel.

—Iron Trade Review.

Tank Plate Fabricators

A National Assocation Forms to Spread Co-operation Throughout This Important Industry

By **F. J. CROLIUS**

ANOTHER important national association has taken form, and to the long list of interests variously identified with the steel industry, which have experienced the sense of values resulting from co-operation rather than competition, is now added the Tank and Steel Plate Fabricators Association.

The final organization meeting was held at the Harvard Club in New York City, February 4, with Mr. George P. Bard as temporary chairman.

This meeting resulted from a sequence of preliminary meetings held during the preceding six months—during the discussions of which various essential committees had been formed, interlocking interests had been communicated with, various interested branches of the Federal Government had advised, and final plans formulated for adoption.

GEORGE MCALEENAN

Active in these preliminaries were: Mr. S. W. Mifflin, attorney of Philadelphia; these following members of the Organization Committee: Mr. Philip S. Graver, Graver Corporation, Chicago; Mr. T. P. Keene, Youngstown B. & T. Company, Youngstown, O.; Mr. Arthur Huehn, J. McNeil & Bro. Company, Pittsburgh, Pa.; Mr. B. A. Shutts, N. Y. C. Iron Works, Hagerstown, Md.; Mr. James Loughlin, Dover Boiler Works, Dover, N. J.; Mr. Charles Koopman, Jr., New England Iron Works, Boston, Mass.; Mr. George McAleenan, McAleenan Bros. Company, Pittsburgh, Pa.; Mr. Ashmore Johnson, Dowingtown Iron Works, Dowingtown, Pa., and Mr. Karl Adams, Smith Gas Engineering Company, Dayton, O.

During the progress of these preliminaries, addresses upon various phases of the new organization's activities were heard from Mr. C. R. Stevenson, of the Stevenson Corporation, N. Y., an expert on costs and uniform cost system; Mr. Clark McKerchner, formerly with Attorney General Wickersham in the Department of Justice, spoke on the benefits of association within legal limits.

The regional plan of organization was adopted, which from an inception of active membership including Pittsburgh (with 18 shops), Philadelphia, Boston and Chicago, will be rapidly expanded to include all districts in the United States. Monthly meetings will be held.

Officers were elected as follows: President, George McAleenan, McAleenan Bros. Company, Pittsburgh; vice president, Philip Graver, Graver Corporation, Chicago, Ill.; secretary and treasurer, S. W. Mifflin, attorney, Philadelphia. Members present and guests at this final meeting were:

Massachusetts — New England Iron Works, Boston, Mass., Mr. Charles Koopman, Jr.; James Russell Boiler Works, Boston, Mr. G. W. Russell. New York —Mr. George P. Bard, 1 Broadway, New York City; Cole Duncan Boiler Works, Inc., Long Island City, Mr. A. M. Duncan; New York Engineering Company, New York, Mr. Edward Steinmueller; The Pfandler Company, Rochester, New York, Mr. Elliott Geisenger and Mr. W. B. Miller; Manhattan Perforated Metal Company, New York City, Mr. John C. Eider. New Jersey — Dover Boiler Works, Dover, New Jersey, Mr. James Loughlin; Beekley Perforating Company, Garwood, New Jersey, Mr. C. D. Gilpin; Tippett & Wood, Phillipsburg, New Jersey, Mr. S. Taylor Wilson. Pennsylvania — McDermott Bros. Company, Allentown, Pa., Mr. Thomas McDermott; Wm. B. Scaife & Sons Company, Pittsburgh, Mr. H. F. Reynolds and Mr. A. M. Scaife; Petroleum Iron Works Company, Sharon, Pa., and 25 W. 43rd Street, New York, Mr. T. H. Munkelt; Sharpsville Boiler Works, Sharpsville, Mr. H. S. Pell and Mr. Charles Fagan; Diamond Manufacturing Company, Wyoming, Pa., Mr. W. M. Powell, Jr.; Hendrick Manufacturing Company, Carbondale, Pa., Mr. A. J. Hamilton; Nazareth Foundry & Machine Company, Nazareth, Pa., Mr. E. O'Shea; R. S. Newbold & Son Company, Norristown, Pa., Mr. Frank Roberts, Jr., and Mr. Wm. Cameron; Downingtown Iron Works, Downingtown, Pa., Mr. Ashmore Johnson and Mr. F. B. Diffenderfer; Treadwell Construction Company, Midland, Mr. W. F. Satterlee; J. McNeil & Bros. Company, Pittsburgh, Mr. Arthur Huehn; Coatesville Boiler Works, Coatesville, Mr. A. W. Edgerton; Allentown Boiler Works, Allentown, Pa., Mr. Francis Collum; McAleenan Bros. Company, Pittsburgh, Pa., Mr. George McAllenan; Sotter

Bros., Inc., Pottstown, Pa., Mr. H. M. Lessig; Lancaster Iron Works, Lancaster, Pa., Mr. A. C. Scully, Mr. Herbert Bate and Mr. Arthur Cavern. Ohio — Lucius Manufacturing Company, Ulrichsville, Ohio, Mr. Charles Scorer; The Stacy Brothers Gas Construction Company, Cincinnati, Ohio, Mr. Paul C. Rodgers. Missouri — Columbian Steel Tank Company, Kansas City and 30 Church Street, New York City, Mr. S. W. Hamilton. Letters and telegrams read from Youngstown Boiler & Tank Company, Graver Corporation, Leader Iron Works and Biggs Boiler Works. Guests —Mr. S. W. Miller, American Welding Society, 33 W. 39th Street, New York; Mr. W. Sparagen, National Research Council, 29 W. 39th Street, New York; Mr. E. E. Thum, The Prestolite Company, 30 East 42nd Street, New York; Professor Adams; Mr. George Link, Jr., of McKercher & Link, Attorneys at Law, 40 Rector Street, New York.

Urge Adoption of Waste Heat Recovery

At the Smoke Abatement Congress recently held in Manchester, England, a contribution of outstanding interest on later developments in steam generation was delivered by Major W. Gregson. In the course of his paper Major Gregson dealt in some detail with the waste heat recovery process, and declared that it was a cheaper source of power production than water power installations. He stated that an extraordinary amount of prejudice against the waste heat recovery process existed among engineers, chiefly because there is a lack of interest in the waste gases once they have completed their primary function. As a result of many investigations personally carried out by him he was able to state that no marketable coal should be used by any colliery, iron and steel plant (apart from its coking and steel works producer coal), or any gas works (apart from its retort coal and proportionate coke for heating the same). He was considerably criticised for this assertion, but answered his critics satisfactorily by referring to actual installations. All the objections there would be—upsetting of processes, frequent shut-downs for cleaning, the need for auxiliary boilers as a standby plant—entirely disappeared in the face of actual practice.

There is a general impression that water power is the cheapest source of electrical energy. Major Gregson, however, proved it to be the fact that waste heat produced power at a considerably lower figure, as the capital charges on a complete waste recovery plant are far less than those maintained with water power installations with their costly head works.

Taking the Severn barrage scheme as a concrete example in Great Britain and adopting the figures given by Professor Miles Walker, the approximate estimate for this scheme is £28,000,000 (normally $140,000,000). Deducting $12,500,000 for the railway and road bridge, this brings the estimate for the complete hydro-electric scheme to $127,500,000, excluding transmission lines. Averaged out over a 24-hour day, the output would be approximately 200,000 hp. This means that capitalization would work out at $637.50 per hp. As an illustration, this may be compared with a typical waste heat recovery electric generation scheme on a much smaller scale—where the prime mover efficiencies are comparatively low owing to their small size. The total capital outlay of the latter was approximately 14½ per cent of that of the water power scheme. Professor Miles Walker has demonstrated that it should be possible to reduce the electrical cost in the Severn barrage scheme by $40,000,000, but even at that figure it works out at $437.50 per hp.

In addition to the adoption of waste heat recovery methods for solving the problem of efficient and smokeless steam generation, Major Gregson said that three other points needed attention — the elimination of hand-fired plants, the development and extension of carbonizing and gasification processes and better designs for effectively burning low-grade fuels. Under the first of these three heads he claimed that the radical cure was to abolish the use of raw coal for all plants too small for mechanical firing equipment, and turn to the use of gas or oil, both of which admit of complete combustion. Running costs are, of course, a decisive factor, but it has to be remembered that small coal-fired boilers are notoriously inefficient and do not adapt themselves to a varying load factor or to long periods of low rate running. But with the gas or oil unit properly designed so that the fuel is properly consumed and the heating surface is so disposed as to give the maximum heat transference from the gases to the water, there is complete automatic control, and the boiler keeps up its efficiency over a very wide load range. Labor is eliminated by the automatic control and there is no fuel handling. Under these conditions it will be realized that higher cost per heat unit is more than counterbalanced by the more effective heat of the fuel under the varying conditions obtaining in ordinary running practice.

With regard to the development and extension of the use of carbonizing and gasification processes, the extension of bye-product coking at collieries and the development of retorting and lower temperature treatment must undergo rapid progress during the next few years. Power generation from the surplus gas from these processes is, according to Major Gregson, the ideal we are all aiming at. He is confident it will mean the linking up of gas and electricity undertakings, and, where geographical conditions permit, a closer co-operation of both with local collieries. The present alienation of the gas and electricity sections of most municipalities ought never to have arisen.

Prof. Fred Crabtree

Prof. Frederick Crabtree, aged 52, head of the Department of Mining and Metallurgy in the School of Engineering at Carnegie Institute of Technology, and a prominent consulting engineer of this city, died in St. Petersburg, Fla.

He was born in Bramley, York, England, February 1, 1867, the son of Joseph and Isabella Crabtree. He came to this country when a young man and was educated in the schools of Lawrence, Mass. In 1889 he graduated from the Massachusetts Institute of Technology, receiving a B. S. degree in chemistry.

He was consulting engineer for the Jones & Laughlin Steel Corporation and many other prominent industrial organizations in this district. He was president of the Engineers' Society of Western Pennsylvania last year. He was a member of the American Institute of Mining and Metallurgy Engineers, American Iron and Steel Institute, American Electro Chemical Society, the American Society of Steel Treating Engineers and the British Iron and Steel Institute.

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The Forging of Automobile Crankshafts*

Automobile manufacturers are demanding crankshaft forgings that require the least amount of machining and which will give nearly perfect dynamic balance.

By JOHN H. NELSON†

NOT many years ago the manufacturers of automobiles were perfectly satisfied to receive a forging which had the general contour of a crankshaft, the main requirement being that sufficient material be allowed such that a crankshaft could be machined from the forging. Today, the requirements on automobile crankshafts are entirely different. The manufacturer is no longer satisfied with a mere forging from which a crankshaft can be machined. He is demanding a crankshaft forging which will go through the machine shop with the least possible stock to be removed, a crankshaft forging made from high grade material, a crankshaft forging which will give as nearly perfect dynamic balance as possible, a crankshaft forging which has uniformity of hardness throughout its entire length, and a crankshaft forging which when installed in the motor will produce a smooth running motor with the least possible wear on pins and journal bearings. With these requirements of the automobile manufacturer, the forging of crankshafts has been reduced from a hit or miss operation to a highly specialized science.

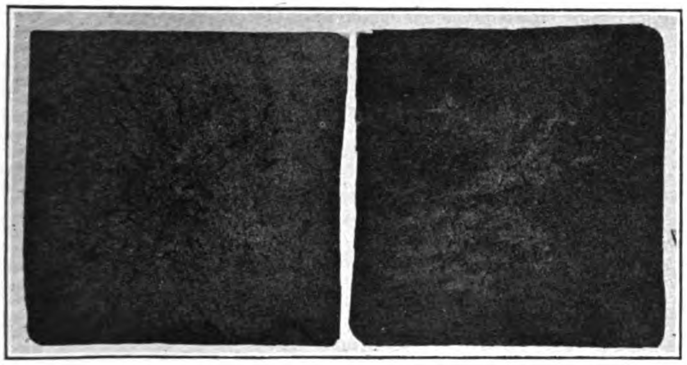

FIG. 1—Forging bars with burst centers.

The first step in the production of a crankshaft meeting all these requirements is the matter of design. Unless the automobile engineer is thoroughly familiar with modern forge shop practice, the design of the crankshaft should be a composite structure comprising all the requirements of the engineer, plus the experience and skill of the drop forger. It is evident, therefore, to secure the best results, very close co-operation between the designing engineer and the engineering staff of the drop forge plant is an absolute necessity. Our experience in innumerable cases has amply demonstrated the value of such co-operation. Oftentimes very slight modification of design combined with experience in forging has resulted in the transformation of a crankshaft of indifferent performance to one which gave excellent results when installed in the motor.

After the design has been completed the problem is then entirely up to the drop forge shop, to reproduce in the forging all the qualities demanded by the designer. The first step in this is that of die design. The particular problem of die design will vary with different shops depending upon the forging methods employed. Die design is comprised of two parts: First, a proper design of a breakdown die which will give proper and uniform stock distribution. Too little attention is generally paid to this very important die. The second step is the design of a finishing die. Some of the factors governing the design of this die are: (a) To sink the contour such that the exact design called for by the crankshaft engineer will be produced; (b) To so design the die that all impressions can be easily filled with an easy flow of metal; (c) To so design the die that the least possible wear will obtain during the forging operations.

The last problem is one of considerable importance, and is not only of consequence in die life, but of equal importance in preserving the quality of the forging. It is well known in the drop forging industry that dies will grow by constant use and if this growth, or enlargement, of the die is not uniform, the result will be a very much distorted forging. In crankshaft forging this growth reflects itself in two ways—First in the addition of stock to be subsequently removed in the machining operation and second in its contribution to unbalance both static and dynamic. If the growth of the die is uniform (a condition which seldom exists) the resulting forging will be one of additional finish and means more work thrown on the machine department, which must machine the finished crankshaft from the forging. It is only by proper design and very diligent checking of dies throughout their life that this condition can be guarded against. However, the best way to eliminate distorted forgings is by close co-operation between forger and user in the initial design. Generally there are several ways a forging may be produced, and usually one of these methods is one which will give the least trouble in die growth. Therefore, if the designing engineer and the engineering staff of the forger co-operate, much trouble can often be eliminated.

Material.

To those who have had experience in the inspection and selection of material for drop forging, no word of caution need be given. To those who have not had extensive experience in this line of work, a description of the inspection methods which we have found necessary in order to secure the best of material and produce the desired results may be helpful.

First. Nothing but the highest quality of forging bars should ever be used in the production of drop forgings. These forging bars should be free from all surface imperfections, such as checks, seams, laps, burns, etc., and this can be readily determined by a surface inspection provided that the bars are not badly covered with mill scale.

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*Forging-Stamping-Heat Treating.

†Research Engineer, Wyman-Gordon Company.

Second. All bars should be required to be stamped with the heat number and these bars kept by heat numbers when received at the stock yard. After the material has been received, a thorough chemical analysis of the material should be made in order to determine whether or not the material meets the specification under which it was purchased. Analyses should also be made to determine whether or not excessive segregation of the elements exists.

The necessity for keeping all heats of steel separate and all forgings made from these heats properly identified throughout the shop such that only forgings made from the same heat of steel will be used in the same heat treating lot is an absolute necessity. To substantiate this with some experimental evidence, attention is called to results given in Table I. The results as here reported are results obtained from production work and not from laboratory experiment. In this table are tabulated results from 108 different heats of steels furnished by several different steel mills to the following chemical specification: C, .40-.50; Mn, .60-.80; P, .04 max.; S, .045 max. These 108 different heats of steels have been grouped according to the drawing temperatures we found it necessary to use to meet a definite physical specification of elastic limit, 70,000 lbs. per sq. in., elongation in 2 in., 20 per cent; reduction of area, 50 per cent; Brinell hardness, 228-248. The chemistry given for each group represents the average chemistry of the steels in that group. The physical tests as reported in this group are the average of 10 physical tests from each heat of steel. The total tests averaged in each group is given in the last column. An examination of this table clearly indicates that the chemistry of the steel is a very poor indication of the heat treatment to be used on the steel to meet a definite physical requirement. The maximum variation in the average of the chemistry of all the steels used is not any greater than would be found in a single heat of steel, but the response to heat treatment of these various groups of steel is entirely different, Group A requiring 980 deg. drawing temperature, while Group H requires 1120 deg. drawing temperature, in order to meet the same physical requirements.

It is also to be noted that the average physical properties developed are practically the same, which clearly indicates that it was absolutely necessary to use these drawing temperatures in order to produce the desired results. It does not require a very great imagination to visualize the results that would have been obtained if a heat of crankshafts made up from all these steels had been heat treated in one furnace at the same time. The result would either be a very large heat treating loss or an exceedingly poor product obtained.

Third. There are many other defects in forging bars which are not readily determined either by surface inspection or chemical analysis. These may be grouped as interior defects, burst centers and gas holes or pockets in the bar. There is only one way known to us to detect these defects and that is by the use of the macro-etch.

To use the macro-etch, transverse and longitudinal sections are cut from the bar and the surface of these sections prepared by grinding or any other means of preparing a fairly smooth surface. These are then etched in an acid solution until the macro-structure of the section is developed. There are various strengths of solutions that may be used for this etching process varying all the way from 10 per cent to 50 per cent solutions. We have found that a 50 per cent hydrochloric acid solution gives very excellent results in the majority of cases. The time of etching is determined entirely by the grade of the material, some grades of steel etching much more rapidly than others. Some of the results of the etching tests are shown in Figs. 1 and 2. Fig. 1 shows transverse sections of a chrome nickel steel heat which has been etched to examine for internal defects. It is to be noted that the cross section of the bars is completely shattered on the interior portion. These cracks, which have been developed by means of the etching solution, extend into the bar in some cases from ¼ to ½ inch. Fig. 2 is a transverse section of bars rolled from effervescing steels. In this it is to be noted that the entrained gases have left cavities and very fine seams are to be observed running from some of these cavities to the surface of the bar. The condition of forgings made from this grade of steel would be a very serious infliction of hairlines.

Fourth. Experimental heat treating of the material should be made in order to determine the response of the material to heat treatment. In making these heat treatment experiments care should be observed to always use a coupon of approximately the same diameter as is to be used on the finished forging to be forged from this stock. It is generally known that some material will respond very readily in small sizes, but will not respond readily to heat treatment in large size. Therefore, if the best results in the forging are to be obtained, only such material as will respond to heat treatment in the forging size should be used.

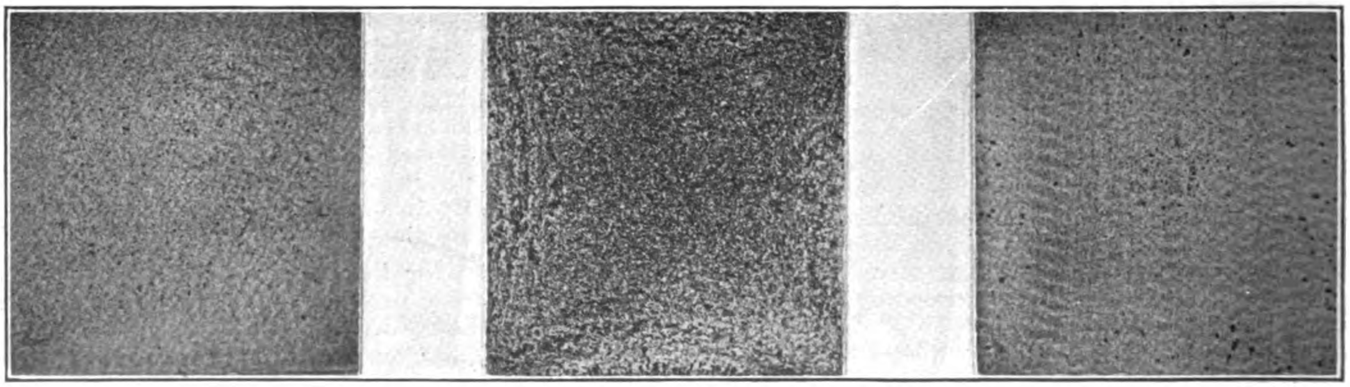

FIG. 2—Transverse section of bars rolled from effervescing steel. Note the cavities formed by the entrained gases. Fine seams are to be observed running from the cavities to the surface of the bars.

Fifth. There is another test which is a very important test to make on all steels which are to be subjected to the case hardening process. This is an examination for normal and abnormal structure. It has been pointed out by H. W. McQuaid and E. E. Ehn* that a steel which has an abnormal structure will, as a general rule, give rise to soft spots in the case hardening operation. The examination for this structure consists of actual carburizing tests combined with a microscopic examination to determine the condition of the cementite.. In addition to this examination, it is well to harden the specimens and make actual tests for soft spots. These soft spots may be detected with a scleroscope, by means of a sand blast or by means of a light pickle. Any one of these will readily detect the soft spots, the method of sand blast or pickling being more satisfactory because both methods will test the entire surface and any difference in hardness may be detected by visual examination.

Forging.

Many people in watching the operation of forging of a crankshaft little realize the amount of experimentation and skill that is back of that operation. The day has passed when the mere filling of the finishing dies may be considered sufficient. The finishing die must, of course, be filled, but care must be taken to place the material in such a way that the grain flow in the finished forging will be placed in the proper position to resist stresses.

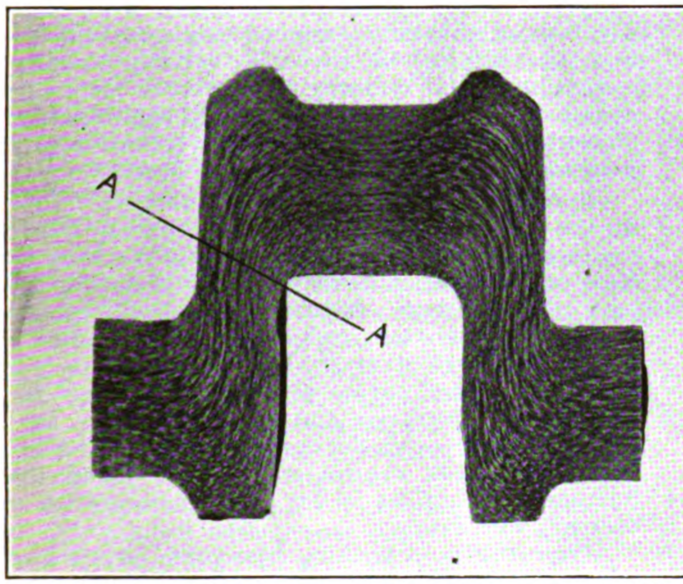

FIG. 3—Properly forged crankshaft.

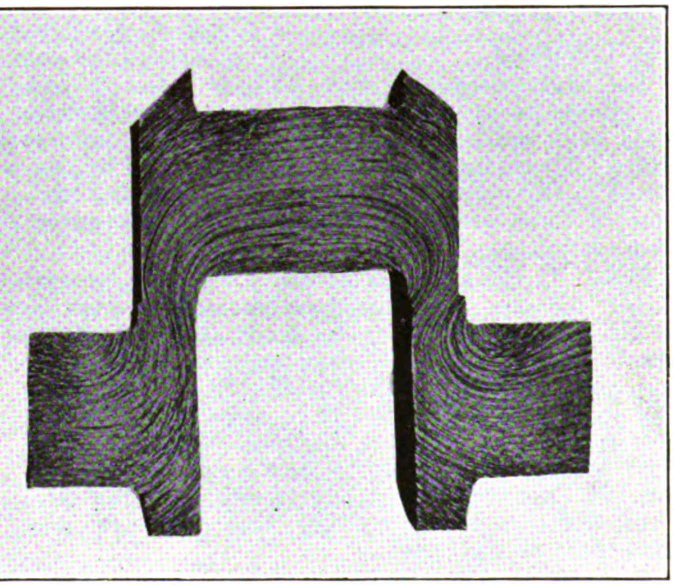

FIG. 4—Improperly forged crankshaft.

Many of the troubles in the heat treating department which are now charged directly to the heat treating operations are really chargeable to improper forging methods. It is only by means of the most careful study of the anatomy of the forgings that are being produced, and by the most vigilant inspection methods, that the highest quality of forgings which will produce the least trouble in the machining and heat treating operations can be turned out.

An illustration of what is meant by this is shown in Figs. 3 and 4. These are taken as an illustration of what may be produced in the same identical finishing die whenever proper care is not exercised in design and operation of the breakdown dies. Fig. 3 shows a section of crankshaft in which the grain flow is all that can be desired. Fig. 4 shows a section of crankshaft produced from the same finishing die, in which the material is so placed that very poor strength in the forging is the result. The critical section in any crankshaft forging is indicated by Section AA. In Fig. 3, the material is so placed that the maximum resistance to rupture by either direct or fatigue stresses is obtained. In Fig. 4, at the critical section the material is so placed that the weakest possible condition is obtained and a forging in this condition is very little better than an ordinary slab forging.

It is generally recognized and fully substantiated by experience that the ability of steel to withstand stress is a direct function of grain. By this is meant that a test or stress across the grain, as shown in Figs. 3 and 4, is weaker than a test along the grain.

The grain flow in a slab forging is shown in Fig. 5, which represents an etched section of a six-throw crankshaft. In this it is to be noticed that the grain of the metal is all parallel to the axis of the crankshaft, resulting in a very weak condition across the cheek at the bearing. A crankshaft made from a slab forging is perfectly satisfactory as an experimental product to determine the behavior of certain engine design, but such a crankshaft should never be submitted to very severe, or even ordinary, usage. The result in such a case would be a failure due to fatigue across the cheek at the danger section. This failure is due to the fact that the material is not placed in the proper position to resist the stresses which the crankshaft is called upon to bear.

In Fig. 6 is shown the grain flow in a seven bearing, six-throw crankshaft, drop forged. A comparison of the grain flow in this crankshaft with a similar type of crankshaft shown in Fig. 5, indicates very clearly the superiority of a properly drop forged crankshaft over a slab forging.

Fig. 7 shows the grain flow in a five bearing four-throw drop forged crankshaft. Here again it is to

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*Effect of Quality of Steel on Case Carburizing Results, Trans. Am. Inst. Mining and Metalurgical Engineers, Vol. LVII, 1922, P. 341.

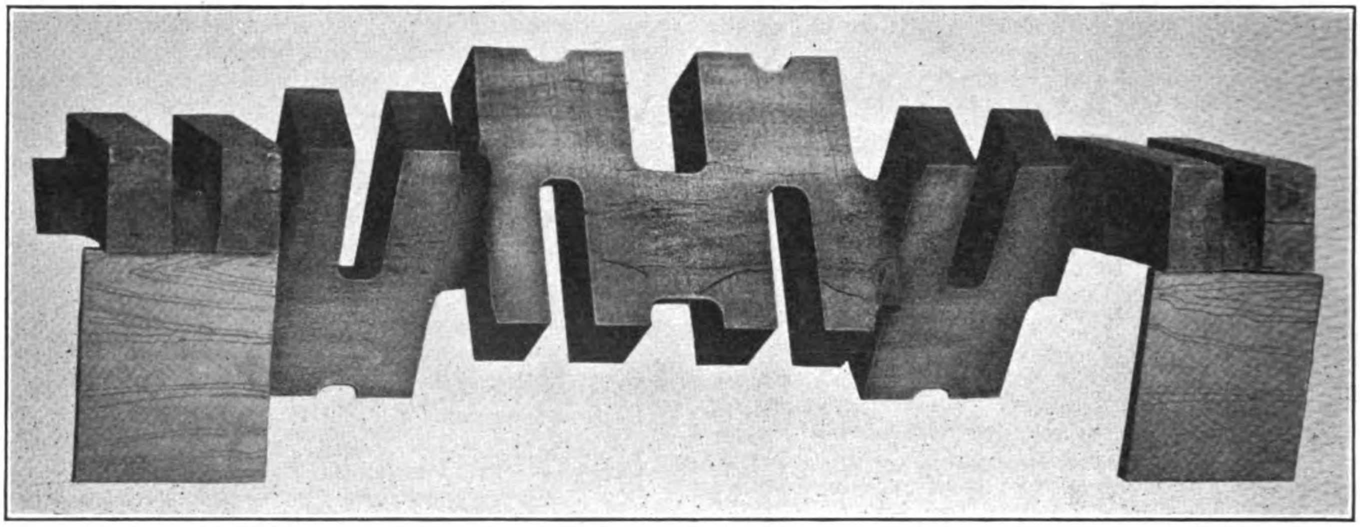

FIG. 5—Grain structure of a crankshaft cut from a slab forging is parallel to the axis.

be noticed that the material at the danger section in all the cheeks is so placed that the greatest possible strength is produced.

Heat Treatment.

The heat treating of steel while in principle is a very simple operation, yet in practice requires considerable skill and experience in order to get uniform results. There are many factors which must be considered in the proper heat treatment of any material. Some of these are not today receiving their proper consideration.

First. In the selection of the material to be heat treated, the one vital consideration must always be the size of the forging to be made from the stock. This is a factor which is often neglected, and many forgings of considerable dimensions are often made up from stock which does not have sufficient hardening capacity to give complete hardness throughout the entire section. The result in such a case is always a hardened case with an extremely soft core, the ratio of case and core depending very largely upon the particular heat of steel used.

Second. In order to properly heat treat material only forgings made from the same identical heat of steel should be heat treated in the furnace at the same time. If this precaution is not taken the result will either be an exceedingly large heat treating loss or some exceedingly poor heat treated forgings. This statement is well substantiated by the results given in Table I.

Heat treating equipment is another factor which has a very decided influence on the results obtained. Only the very best equipment should ever be used. The furnace should be designed to give as nearly uniform heat throughout the entire heating chamber as is possible. This we have found can be very readily done and the furnace be balanced up before putting in production such that the maximum variation in temperature in the furnace will not be over 10 deg.

Pyrometer equipment should be that most suitable for the local conditions. Automatic control of furnace temperature is an absolute necessity. We have found from our experience in the past five years that a furnace operated with automatic control will produce a uniform product that is absolutely unobtainable with the hand control method. It is possible with a good automatic control output to bring your charge to the prescribed temperature and hold this charge for any length of time with a fluctuation not to exceed 5 deg., while with hand control it has been found that a fluctuation as high as 50 deg. in temperature is a very ordinary fluctuation.

After the heat treating operation, every forging which is finished heat treated by the forging concern should be very carefully Brinelled in order to determine the uniformity of the operation. This simple operation of making Brinell hardness tests is one which is very often improperly done. It is to be remembered that in all forging operations it is necessary to use a comparatively high heat, in order to insure sufficient ductility of the metal to flow in the

TABLE I

Group	Draw Deg. F.	C.	Mn.	P.	S.	Yield Point lbs. per sq. in.	Tensile Strength lbs. per sq. in.	Elong. in 2 in. per cent	Cont. in area per cent	Brinell Hardness	Number of Tests Averaged
A	980	.43	.65	.012	.043	74,280	111,220	20.1	51.3	228	60
B	1000	.43	.69	.016	.041	77,540	115,900	20.8	52.8	238	110
C	1020	.47	.69	.018	.041	77,300	115,950	21.6	53.6	236	90
D	1040	.47	.73	.021	.044	77,500	115,750	21.3	52.9	238	230
E	1060	.46	.71	.024	.042	77,420	114,980	21.6	54.3	238	120
F	1080	.46	.71	.028	.046	79,100	117,200	20.8	53.1	240	170
G	1100	.45	.75	.021	.042	76,900	114,600	22.1	55.2	241	110
H	1120	.45	.77	.032	.044	78,500	115,750	21.7	56.0	243	190

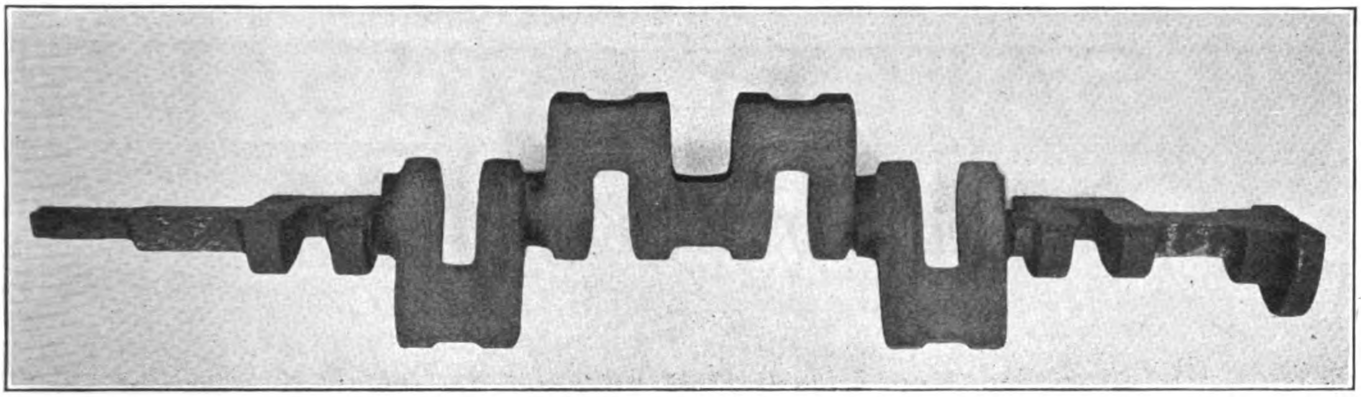

FIG 6—Drop forged crankshaft. Compare grain structure with that in FIG. 5.

dies. This high heat has a certain amount of decarburizing effect on the surface of the forging. Care should, therefore, be taken in preparing for the Brinell hardness test to be sure that all decarburized material has been removed and that a good smooth surface has been produced in order that the diameter of the ball impression may be accurately read. If proper furnace equipment is not provided, it may be necessary on long pieces, such as front axles, crankshafts and similar parts, to make two or three Brinell hardness tests on the same piece in order to be insured of uniformity throughout the entire forging. If this is not done it is very likely that one end may prove of proper Brinell hardness while the opposite end may be exceedingly hard or exceedingly soft, depending upon the furnace conditions.

Too much emphasis cannot be placed upon this very important test, as it is the only means that the user has of being assured that the forgings which he is receiving will be within the specification limits.

Working conditions should also be studied in order that the best results may be obtained. If, as is too often the case, the heat treating department is placed in an out of the way, poorly illuminated and improperly ventilated part of the forge shop, the best results cannot be expected. The heat treating department should be equipped with proper handling devices to facilitate the handling of heavy forgings, as well as the proper handling of light forgings.

Another condition which is not conducive to the best results, is the practice used in many shops of quenching small forgings in baskets. There is no question but what this is more economical than that of handling forgings as individuals, but we have found from our experience that from a quality standpoint the question of handling all vital small forgings as individuals, or in very small quantities, is highly desirable, and absolutely necessary if uniformity is to be obtained.

Finishing Department.

There are a great many different types of crankshafts which may be classified according to the number of throws and the number of bearings used. Each class of crankshafts must be dealt with entirely as a separate entity both in design, in the forging and in the finishing operations. In the design of the crankshaft proper precaution has been taken as to the distribution of the material in order to insure a well balanced crankshaft both statically and dynamically after the forging operation.

An analysis of the parts of a crankshaft show it to be made up of three separate and distinct parts, first, the journal bearings, second, the pin bearings, and, third, the cheeks or webs.

The pin bearings on the four-throw crankshafts are usually all in the same plane. In the six-throw crankshaft, these pin bearings are placed at an angular distance of 120 deg. In the eight-throw crankshaft, that is, the straight eight crankshaft, the pin bearings are placed at an angular distance of 90 deg. This angular distance must be held to very rigidly in order to produce a crankshaft which will give the least possible trouble in the machining and balancing operations. The pin bearings are all more or less accurately machined with respect to the axis of rotation of the crankshaft, such that very little out of balance in the crankshaft is ever experienced from the pin bearings. The same is true with respect to the journal bearings.

(Continued on page 142.)

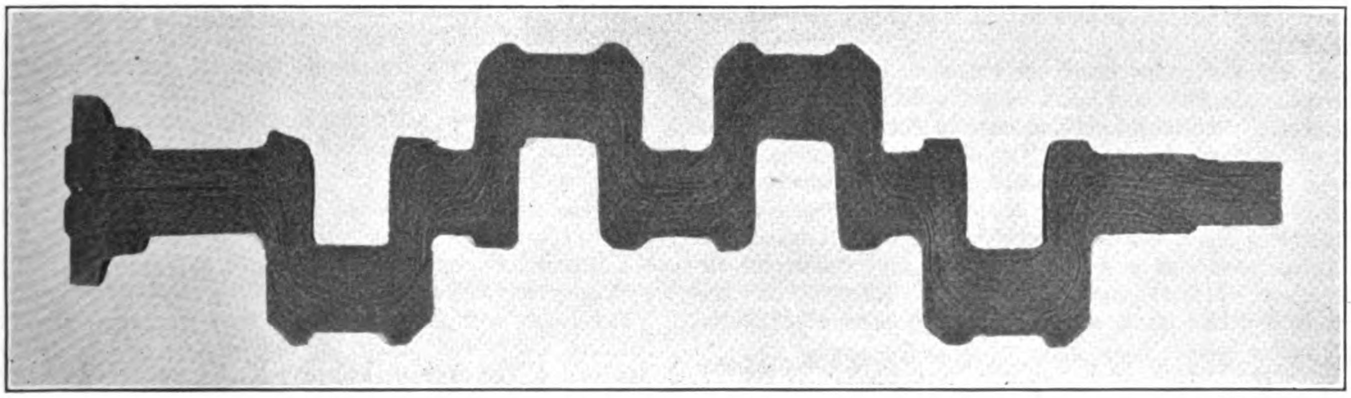

FIG. 7—Drop forged five-bearing four-throw crankshaft. Grain structure arranged to give maximum strength.

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THE SAFETY CRUSADE

Industrial Lighting*

Its Importance As a Safety Factor Now Generally Recognized

By CHARLES J. STAHL†

Familiarity with the conditions which surround the working hours of employes in heavy tonnage plants leads one to the conclusion that the 'better light" campaign has but just begun.

Thanks to the Safety impulse, the eyes and minds of executives have been opened to the value of illumination. Careful study of accident statistics invariably reveal the fact that Safety follows Light, and that Light is very cheap insurance.

IN the past 10 years there has developed a greatly enhanced appreciation of the value of good industrial lighting, brought about principally by the following developments:

1. Industrial research conducted by the manufacturers of lighting equipment in co-operation with central stations supplying electric service.
2. The production of better lamps and media for the efficient control of light directly to the purposes for which it is required.
3. The demand for increased production and decreased production costs.
4. The educational work of the societies and associations represented by this gathering including the Illuminating Engineering Society and others.
5. Last, but not least, the necessity of conserving the human eye under the demand for greater accuracy and the necessity for reducing the appalling number of accidents brought about by the use of powerful machines, overlapping operations and the desire for speed.

Adequate lighting results in the following benefit as set forth in a recent publication issued by the National Safety Council:

1. Reduction in accidents, greater accuracy in workmanship, decreased spoilage of product, increased production for the same labor cost, lessened eye strain, better working conditions, less labor turnover, better order, cleanliness and neatness in the plant, easier supervision of the men.

Coincident with the changes in the general public's attitude toward the value of good industrial lighting has come a fundamental change in the attitude of the manufacturers of lighting equipment. In the past, their efforts were to sell more lamps and more reflectors with little concern as to their proper application and use. Today their attitude is to sell illumination. Manufacturers now have engineers and scientists engaged in determining the effects of different intensities and other qualities of various grades of artificial lighting upon human efficiency, happiness, national economics and social developments.

Artificial lighting in industry is now regarded as the potent agent of constructive force and it is steadily exerting a greater influence and benefit upon our civilization. It is known to be of first importance in the prevention of accidents. It is a great aid in solving the problems of night traffic in our cities. The right or wrong use of lights will conserve or impair the eyesight of the younger generation which is soon to enter the great army of industrial workers. Conservation of eyesight is of great economic benefit and is an assurance of fewer needless accidents in years to come.

An excellent example of sheet storage illumination.

Lighting codes so far established are virtually safety codes for they deal with very moderate intensities over all shop areas. The proper degrees of illumination from considerations of manufacturing efficiency are above those specified in the present codes. In general, the enforcement of lighting codes has been quite as beneficial to the manufacturer and society as a whole as to the individual workman.

George Earl Wallis, editor of the National Safety News, and director of publicity for the National Safety Council has resigned from those capacities. His new connection will be as publicity counsellor for the Reincke-Ellis Company, Chicago, an advertising organization. Carman T. Fish, for the past two years associate editor of the National Safety News, succeeds Mr. Wallis as editor. Mr. Fish previously was associate editor of The Inland Printer.

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*This is an abstract of a paper read before the Baltimore Safety Conference, Baltimore, January 23, 1925.

†Manager, Illuminating Engineering Bureau, Westinghouse Electric & Manufacturing Company, South Bend, Ind.

United States Public Health Service

"Heart disease has supplanted tuberculosis as the greatest man-killer."

This assertion was made by Dr. Robert H. Halsey, of New York, in a paper presented to the American Association for the Advancement of Science at its last annual meeting in Washington, D. C. The assertion is further substantiated by Dr. Stewart R. Roberts in a paper recently read before the Southern Medical Association in New Orleans, and by figures just given out for the year 1923 by the United States Department of Commerce. Dr. Roberts not only places heart disease as the most deadly destroyer of human life, but he also points to syphilis as one of the greatest causes of heart disease. It was said at the meeting that syphilis is responsible for 52 per cent of all heart troubles.

According to statistics compiled by the Department of Commerce for the registration area, comprising 87.6 per cent of the population of the United States, heart disease claimed 170,033 lives in 1923, as compared to 105,680 deaths caused by pneumonia and 90,732 by tuberculosis. Syphilis is credited with a toll of 15,811 deaths.

"If the above figures are correct", says the Division of Veneral Diseases of the United States Public Health Service, "syphilis may also be held responsible for 52 per cent of all the deaths resulting from heart trouble, or 88,417 fatalities. When this sum is added to the 15,811 deaths credited to syphilis by the census figures, the result is a total of 104,228 deaths caused by syphilis directly or indirectly, and this total is arrived at without taking into consideration deaths caused by some other diseases which are in many cases a result of syphilitic infection. Experiments recently made in Paris would seem to indicate that 76 per cent of syphilitics have heart trouble. Out of autopsies on 155 known syphilitics there were 115 cases in which vascular lesions of the heart were found.

"Heart disease has both economic and public health aspects," said Dr. Halsey in his paper. "Heart disease is associated with large economic losses, this ailment being the largest single cause of death we know today. Comparing present and past rates, there appears to be an increase in the mortality from heart disease, and life expectancy has been greatly decreased as a result", he went on.

Dr. Stewart asserted that there was no more excuse for having syphilis than leprosy; and that while a great portion of all heart diseases come from syphilis, the other portion comes from degeneration and afflictions of the rheumatic group, most of which, like syphilis, are entirely preventable. Syphilis has its most dangerous effects on the heart between the ages of 45 and 55, although it takes its toll at nearly all ages, said Dr. Stewart.

Both Dr. Halsey and Dr. Stewart advocated a wider dissemination of knowledge to dispel the ignorance from which nearly all diseases that lead to heart trouble are born.

Safety Publication Contest

Previous to the 1924 Congress of the National Safety Council which was held in Louisville, Ky., during the first week of October, the Plant Publication Section announced a prize contest for plant magazines. All types of plant publications were allowed entry. No restrictions were made as to size or class of publication, advertising or non-advertising, either of product or other accepted paid advertisements nor any other distinctions. It was announced that each entry would be judged on the basis of six points, class of articles, class of cuts, quality of printing material, style of composition, style of make-up, and class of press work.

Originally it was planned to announce the selections during the Congress but the large number of entries made this impossible. Further time was granted the judges, which accounts for the delay in announcing their decisions.

Mr. W. H. Cameron, Managing Director of the Council, advise the selection of "The Mixer" as one of the four outstanding publications among the hundreds entered in the contest. Mr. Eib expresses the thoughts of Joliet as follows:

"We are indeed grateful of the honor which has come to us individually and the appreciation of our efforts by the good people who devoted many hours of their time in this huge task. We are even more grateful to the good folks here on the plant, and especially the Department Reporters, who have helped with their suggestions and their contributions in making possible your magazine. The chief reason for gratification is not so much from any personal standpoint but more from the standpoint that whatever our own efforts may have added to the policies and aims of our plant executives, our Company executives, and our Corporation executives, is mainfestly evidence of the worth-whileness of the entire endeavor."

The New Year.

As we start out on the New Year we cannot help but look back at the achievements and safety records which have been made at Joliet Works, during 1924, all of which are of such importance and are such a huge contribution to the entirely worth-while effort of accident elimination that we are truthfully and rightfully proud of our contribution to this great humanitarian cause.

It does not take many words nor a great deal of time to mention such records but the amount of effort and thought and preparation which has been put into our campaign means a great deal.

The attainment of such a record did not just happen, but was the result of weeks, and months, and years of patient, consistent and never-ending effort and devotion to a cause which is absolutely and entirely right and all of the years of effort and co-operation by all concerned on the plant uniting in a determined effort to win made possible the successful achievement which has been ours during the past year and when we say that everyone of us are proud, we mean every employe regardless of rank or position.

With the closing of the old year our accident record for 1924 becomes history and our thoughts and efforts are turned to the New Year which finds us all determined to carry on the accident prevention work, which means men on the job instead of in the hospital; full pay checks and happier homes. To eliminate accidents we must keep safety foremost in our minds. There is truth in the sage's lines which read:

> "There is no past, no future is,
> But an eternal now!"

The past was; the future will be; the present is. So it is in accident prevention — not what we have done or are going to do but what we are doing now to prevent accidents.

* * *

Omar, the Persian tent maker, must have been thinking of accident records when he wrote those lines 850 odd years ago: "What has been recorded can't be changed but it can be of value if it shows us how to avoid the same mistakes in the future."

Remember the lessons of past accidents but don't waste time in useless regrets. Today, tomorrow and the following days are ours to improve on our past successes.

Our Accident Record.

Rank for 1924 as of December, 31st		Rank for Year, 1923
1.	Blast Furnaces	14
1.	Spike Factory	12
1.	Merchant Mill	18
1.	Splice Mill	9
1.	Yard Department	16
1.	Bolt and Nut	2
1.	Foundry	15
1.	Electrical	3
1.	Masons	4
1.	Roll Shop	6
1.	Narrow Gauge	5
1.	Cooper Shop	7
13.	Mechanical	10
14.	Coke Plant	8
15.	Converter	17
16.	Rod Mills	13
17.	Billet Mill	1
18.	Boilers	11

Twelve of the 18 departments of the plant succeeded in going the entire 12 months of the year without an over seven day or serious accident and nine of these departments without a lost time accident.

The accident records for the year show a decrease of 39 lost time accidents and a decrease of 18 over seven day and serious accidents, a decrease of 72 per cent in the frequency of accidents and a decrease of 72 per cent in the severity of the accidents last year over the year 1923.

"We'll win because we Will to Win!"

Preventable Accidents.

The safety records and accident ledger for 1924 are closed and the accomplishment made in accident prevention, by the united efforts on the part of each worker on the plant to eliminate accidents and make Joliet Works safe for every one has made history in this great humanitarian movement. Every effort has been made to make conditions safe and that we have profited by the lessons of the past, that we realize to enforce discipline, guard all machinery and display danger and warning signs without a systematic plan of safety education wherein each employe will understand the principles of accident prevention to enable him to give serious thoughts for his safety, to safety first, that he may practice at all times and in all places those principles was thoroughly demonstrated by last year's record, a reward of less injuries and accidents, less suffering and regrets and more happiness and contented homes.

With our company showing its interest in your welfare and in this great humanitarian movement of preventing all accidents, effecting the welfare of the whole community, it is right that each one of us should give serious thought to the work of accident prevention, observe all rules and regulations regarding our work and safety and prevent those accidents caused by the failure to observe the safety rules as well as to assist others to overcome their tendencies to indulge in practices known to be dangerous, in striving to cultivate, with our united efforts, those things that pertain to the life and happiness of all.

Nothing surpasses in value this great humanitarian effort to educate our fellow workmen in safety and place accident prevention work above everything else. The way to reduce accidents is by education and not until this task has been accomplished will the accident rate be reduced to its proper place.

To assist those who are earnestly endeavoring to educate all workmen in the prevention of accidents and injuries, the "Mixer" columns contain several accident causes pointing out the hazards existing on our plant and where the hazard has actually caused an accident and injury, in the majority trivial injuries, which in time will develop into more serious injury and grief. These causes show the lack of care or thought on the part of the injured man and in each instance a suggestion is offered for their prevention.

It is not the idea of the "Mixer" in publishing these causes to censure any one individual for an accident or having an injury but these causes are cited merely to assist you in preventing a like hazard and possibly a serious injury to you or to your fellow workman and it is hoped that with your united support and effort each month's publication will assist you and a lesson will be gained.

The strength of the safety organization at Joliet Works depends upon the strength of the first line of defense and the amount of effort displayed to educate all in the prevention of accidents will determine the number of accidents and will make our record for the year 1925.

Two incidents are worth analysis:

A workman was using a bar to straighten a billet on charger. After bar had been placed he gave charger operator a signal to move ahead but charger was operated in the opposite direction and bar swung around striking him in the side.

The practice indulged in by the man with this bar, creating this hazard, is poor practice and should be eliminated. When any unusual condition or practice arises consult your superior for advice and under all conditions and at all times get into the clear before giving a signal to move machinery to conform to the safety rules and regulations regarding your work.

Accidents from this cause are absolutely certain to continue so long as the hazard exists. Eliminate the hazard caused by the human element and you eliminate the accident and injury.

Injured man was helping in punching holes in angle bars on punch machine. First hole had been punched when injured man placed his hand and a stripper behind the bar. When punch was operated his finger was caught between stripper and bar. This machine is equipped with a long handle for the purpose of preventing accidents of this nature when operated with intelligence. The delay caused while you are getting into the clear before operating machine costs you nothing—why take the chance?—The "Mixer".

Some Details of the "Holbol" Process

A New Method of Making Hollow Balls Out of One Piece or Metal Without Seams, Joints or Plugs—A Reduction of from 60 Per Cent to 70 Per Cent in Weight

FOR a number of years past there has been a growing demand for a light, strong, well-balanced metal ball. In two fields was this demand particularly pronounced. In valve applications a ball combining lightness with strength and balance means not only an improved sensitivity but also a substantial reduction in the pounding shocks and the avoidance of localized wear and consequently a longer life to both ball and seat. In bearing applications, especially in thrust bearings, a hollow ball would mean a reduction in centrifugal force as well as the elimination of the severe internal stresses which, at the present time, limit the application of larger balls.

Ball manufacturers have attempted to meet this growing demand in two ways. For light duties, such as floats, hollow balls are stamped from sheet metal in two halves, brazed together at the "equator." A section of a ball of this type is shown in the figure. Balls of this type are used only in such applications where lightness is the main consideration, and strength and balance are of secondary importance.

For heavier duties, as for instance deep well pumps and large check valves, cast bronze balls such as are shown in the center are used. The slight reduction in weight achieved by this method is more than offset by the imperfect balance and poor physical properties of the surface. When balls of this type are applied to valves they have a tendency to always meet the seat in the same position and this localized wear shortens the life of the valve considerably. Besides, neither of the two types of hollow balls are commercially available in sizes under 1½ inch.

The problem of producing a hollow ball possessing the minimum weight consistent with valve duties and as strong and well balanced as a solid ball has been completely solved by the discovery of a new process of working metallic surfaces in a cold state. The basic patents for these processes are controlled by the Hollow Ball Company, Incorporated, Baltimore, Maryland, and the product is marketed by that company under the name of "Holbol." Any commercial metal or alloy procurable in strip or tube form can be used in the manufacture of Holbols. At the present time Holbols are made in Monel metal, brass, copper, aluminum and steel in sizes which range from ¼ in. to 3 in. in diameter.

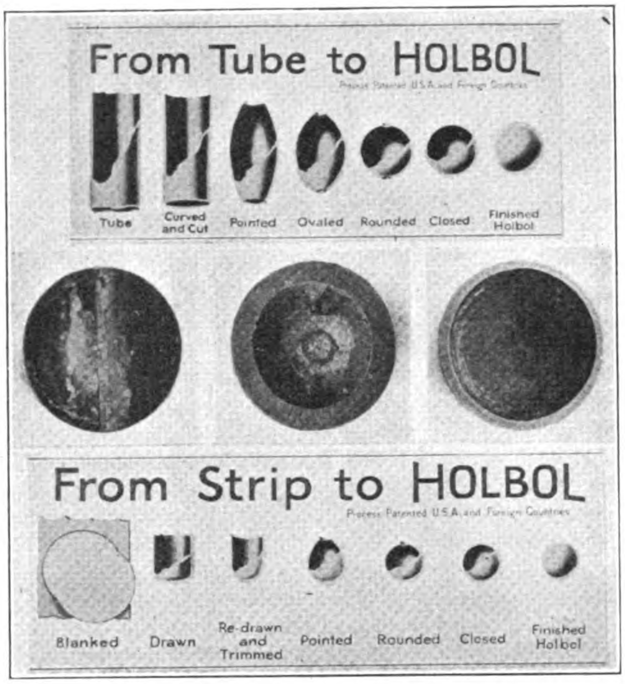
The ball produced by the Holbol process consists of a single piece of metal pressed and rolled while cold into a homogeneous, flawless shell, free of seams, joints and plugs and, therefore, possessing an inherent perfect balance. A section of a Holbol is shown in the figure.

Two methods are used in the production of Holbols. In the first—the strip method—used in making Holbols from ¼ in. to ¾ in., the raw material is metal strip. This latter is successively put through a series of press operations, the different stages of which are iluustrated by the bottom row shown.

In the tube process, used for larger balls, the tube is tapered preliminary to the press operations as illustrated, the object of this tapering being to ultimately secure a uniform wall thickness at every point of the completed ball.

The Closing Operation.

On the completion of the press operations the blank emerges in the form of a nearly spherical shell. However, whether the strip or the tube method is used, one or two apertures still remain to be closed and it took years of painstaking experiments as well as brilliant ingenuity to devise a method for closing these openings. The epoch making idea by which this closing was finally effected is incorporated in the rolling machine.



By means of a hopper the balls are fed between the matched grooves of two steel plates of which one is stationary while the other revolves at a moderately high speed. The two plates can be drawn together by means of a screw operated by a hand wheel. In this way a tremendous pressure can be brought to bear on the balls while the latter, due to the special configuration of the grooves, are given a combined rolling, spinning and gyrating motion successively exposing every point of the ball to the strenuous action of the hardened, accurately ground steel plates.

What actually happens to the metal in this rolling action can be described as follows:

Under the gradually increasing pressure the volume of the ball contracts while the strenuous rolling action distributes the "flowing" metal uniformly along the surface of the ball. Not only are the holes com-

(Continued on page 142.)

The Electric Soaking Pit*

Donner Steel Company Now Successfully Operating This Innovation

By T. F. BAILY†

THE electric heating of soaking pits has been under consideration for more than 10 years, and has been the subject of several papers before technical societies; and while on every occasion considerable interest was shown, it seldom went further than "where can we see one in operation?" Among those who were not familiar with the technical side of electric furnace design and operation, there was a belief that electrically heated pits could not compete with gas fired equipments, and while it was generally conceded that electric pits would reduce the scale on the ingots, many were of the opinion that it was necessary to scale ingots heavily in order to produce a good surface on the bloom. These various contentions remained somewhat open questions until the installation of the electric pit at the Donner Steel Company last March.

Since that time, 700 ingots both of carbon and alloy steel have been put through this pit and a comparison of these ingots with other ingots of the same heats put through gas pits, together with a description of the electric pit, is the subject matter of this paper.

Description of the Electric Pit.

The pit is of 150 kw. electrical capacity with outside dimension of approximately 8 ft. wide by 9 ft. long by 10 ft. high, with internal dimensions of 3 ft. wide by 5 ft. long and 8 ft. deep, holding two 6,800-lb. or 7,400-lb. ingots. The electric heating is accomplished by means of carbon resistors, using crushed carbon of approximately ¼-in. mesh contained in troughs made of carbide of silicon. This type of resistor is the only one so far developed that can operate successfully at temperatures to be met with in soaking pit practice. The power input is controlled by means of special transformers having a number of voltage taps on the secondary, each tap giving a different k.w. input to the furnace.

The resistor units are located in the side walls of the furnace, in such a manner that the ingots cannot come in contact with them, the slap of the ingot in charging being taken by heavy firebrick walls projecting beyond the resistor troughs; and while the pit has been in service several months, no repairs have been required to these walls nor to the cover, whose brick is in perfect condition, although heating ingots to a temperature of 2,350 deg. F., or above, and at times for experimental purposes, has been called upon to maintain furnace temperatures of 2600 deg. F.

The Transformer Equipment consists of a 150 k.w. Packard, 25-cylcle, single-phase transformer, which was sometimes called upon to carry 50 per cent overload continuously. The meter equipment consisted of a Weston Indicating Wattmeter, a Westinghouse Graphic Recording Wattmeter, and Brown rare metal couple Graphic Recording Pyrometer with the couple located in the cover of the pit directly above the ingots. The temperature readings were checked by means of a radiation pyrometer, which instrument was also used to take the temperature of the ingots going to the pit, when they were on the way to the mill after leaving the pit, and while they were in the mill. As the blooming mill was steam-driven, it was not possible to obtain reading of relative power requirements in rolling between electric and gas heated ingots, but the finishing mill was electrically driven and the comparative results on rolling given in Table 1, are taken on this mill. Had it been possible to take similar readings on the blooming mill the relative difference in power readings between the gas and electrically heated ingots would, no doubt, have been even more marked.

The loss of metal due to scale was determined by means of an ingot scale located at the entrance of the blooming mill, ingots of both the gas and electric pits being weighed after stripping and before charging in the pits, after heating and before rolling, and finally after the fourth pass in the mill.

Power Required for Heating.

While it was not possible on account of plant conditions to operate the electric pit to the best advantage except on a few occasions, the power consumption for heating was well within the figures made before the equipment was installed. During the month of November, 101 ingots of an average weight of 3.3 gross tons each were heated, and during this period the power was on the pit 624 hours, but ingots were in the pit only 92 hours, and during this time, the pit under these conditions, the total power consumption was only 189 k.w.h. per gross ton of metal heated.

Taking the average practice, however, between November 16 and Dec. 2, charging the pit with power only during the time ingots were in the pit, the power consumption was 80.4 k.w.h. per gross ton of ingots heated when heating two 3.3 ingots at a time to an average temperature of 2,316 deg. F., the skin temperature of the ingots charged being 1,660 deg. F.

During the period mentioned above, on account of mill conditions it was necessary to hold the ingots in the pit on some occasions as long as 16 hours and 40 minutes, while under the best conditions the time in the pit was only 1 hour and 40 minutes, although it was found that an average period of 2 hours was quite sufficient for ingots charged at a skin temperature of 1600 deg. F. and heated to 2350 deg. F.

Had it been possible to operate the pit continuously on a two-hour soaking schedule, the power consumption would have been considerably under 75 k.-w.h. per gross ton, as occasional daily operation showed power consumptions under this figure. It should be kept in mind that the heat loss through the walls of this small pit was large compared with the heating capacity of the pit, and that a full size pit of four 6 ft. by 8 ft. holes would show much better economy. From a careful check on the wall loss of this pit

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*Paper presented before the Association of Iron and Steel Engineers, Pittsburgh Chapter.

†President, Bailey Furnace Company, Alliance, O.

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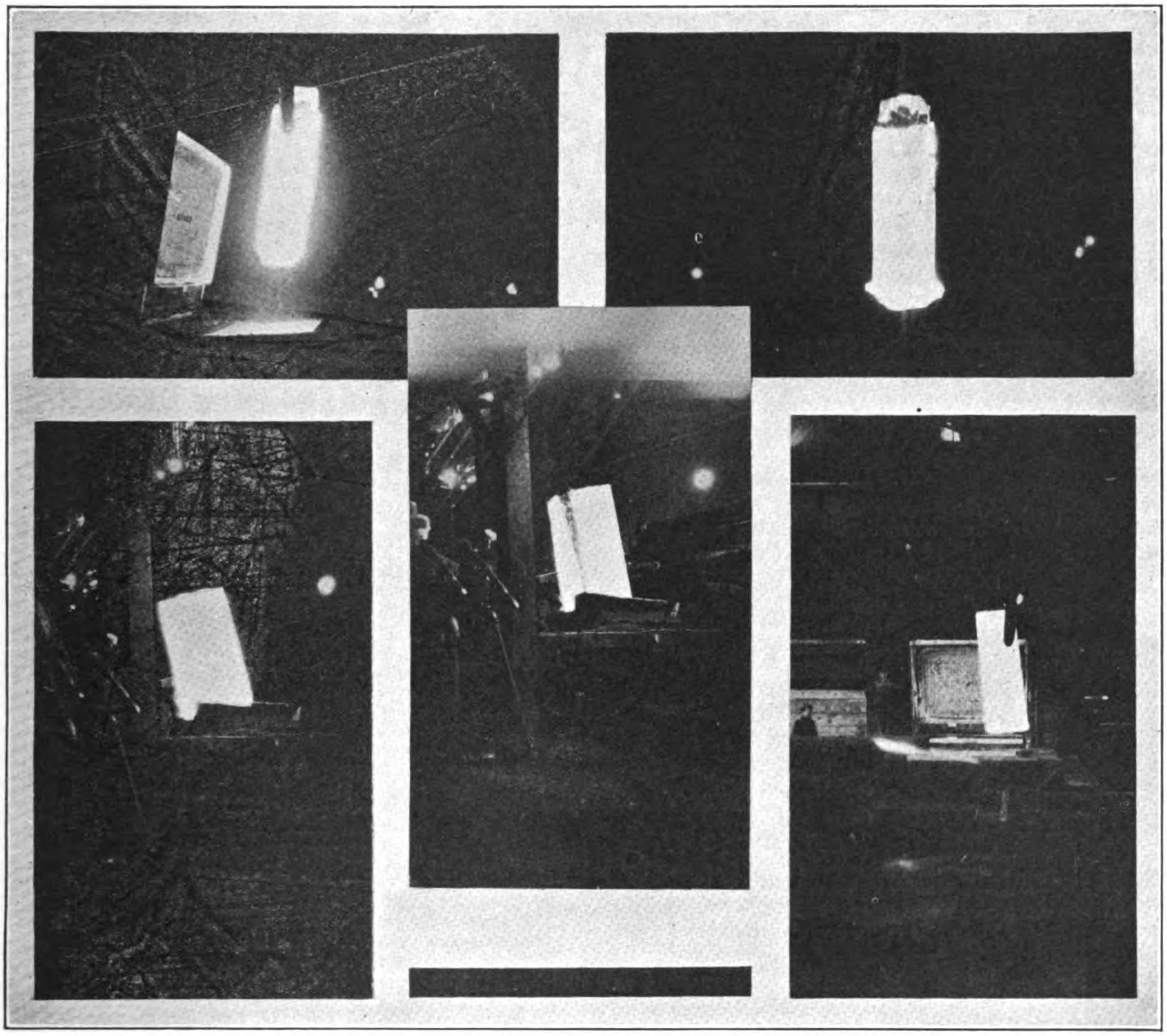
during the period mentioned of the 75 k.w.h. used for heating, approximately 30 k.w.h. were chargable to wall loss, leaving 45 k.w.h. as the heat actually required for the steel per gross ton; while in a full size four-pole pit holding twenty-four 3.3 ton ingots, and operating on a similar heating period, the power chargeable to the wall loss per ton of ingots would not exceed 15 k.w.h. per gross ton of ingots put through the pit when the ingots were charged at a skin temperature of 1,670 deg. F. and heated to 2,350 deg. F.



Upper left—7400-lb. chrome nickle ingot coming from electric pit. Upper right—7400-lb. chrome nickle ingot coming from gas pit. (Same heat as No. 1.) Lower left—6800-lb. carbon ingot, electric heated, in ingot buggy. Center—6800-lb. carbon ingot gas heated. Same heat as No. 3 in ingot buggy. Lower right—6800-lb. 40 carbon ingot coming from electric pit.

With a higher charging temperature of say 1,850 deg. F., which is possible on most steels the power consumption should not exceed 45 k.w.h. per ton; and with ingots charged at 1,670 deg. F., and heating to only 2,250 deg. F., the power consumption should be under 50 k.w.h. per ton.

When heating cold ingots in a full size pit, using 6 hours as the heating time and heating to 2,250 deg. F., the capacity of the pit would be 10 tons per hour and the power consumption 330 k.w.h. per ton of ingots heated. This power consumption makes electric heating prohibitive from a cost standpoint on low grade steels; but on high priced alloy or high speed steel, the saving due to the reductions in scale loss may easily compensate for the higher-cost of fuel or power for the electric pit. Since by far the largest tonnage of ingots are charged into the pits at temperature near 1,670 deg. F., the calculations of power consumption for full size pits are based on steel going into the pit with that temperature.

These figures appear in Table 2. It is to be noted from this table that when taking into consideration the saving in scale that no fuel fire furnace can compete in cost with electric heating under the conditions named.

Scale Loss from Ingots.

One of the most interesting features of the test on the electric pit was the determination of metal loss in scale. Both electric ingots and gas heated ingots were weighed before charging into the pits and after the fourth pass in the mill. The average loss of electric heated ingots was ¾ per cent, and on gas ingots substantially 1¾ per cent. The scale loss on electric ingots seemed to be about the same regardless of the time the ingot was in the pit, an indication that this ¾ per cent loss was caused by the air striking the ingot after stripping and before charging into the pit. In the case of the gas heated ingots, the scale increased as the time in the pit was increased. While the record of loss on the gas heated ingots in this case was only 1¾ per cent, it is believed that this figure is too low for average practice, as records taken from a number of other installations of gas heated pits indicate that a scale loss of 2¾ per cent is more nearly the average loss.

The difference in scale is best shown by Figs. 1, 2, 3 and 4. Fig. 1 is a 7,400-lb. chrome nickle ingot heated in the electric pit. Fig. 2 is an ingot of the same heat heated in the gas pit, taken at the same number of seconds after removal from the pit as the picture of the electric ingot. Both ingots approximately 2,350 deg. F. Fig. 3 is a 6,200-lb. carbon ingot heated in the electric pit, and Fig. 4 is an ingot of the same heat put through the gas pit. Fig. 5 shows the top of the electric pit with cover open and an ingot being removed from the top.

Surface of Blooms.

The operation of the electric pit demonstrated conclusively that the bloom coming from electric heated ingots had better surfaces in all cases, except perhaps in such cases where the ingots were very scabby; under such ingot conditions there was no advantage in surface conditions of the blooms by electric heating.

Power Required in Rolling.

Due to the fact that the ingots from the electric pit could be and were heated to the desired rolling temperature, and were perhaps more evenly located throughout, the power required for rolling electric ingots was less than for gas ingots heated to the same skin temperature, and it was also noted that the peak load on the mill was less when rolling electric ingots than when rolling ingots heated in the gas pits. It will be noted that in Table 1 the average peak load demand was 9 per cent less for electric ingots than for the gas heated ingots, and that the k.w.h. per ton for rolling electric ingots was 25.8 per cent less than for the gas heated ingots. This can be best accounted for by the assumption that the electric ingots were more evenly and thoroughly heated, which is borne out by the temperature readings in Table 1, which shows that there was less drop in temperature of the electric ingots between the 4th and 9th pass.

Space Required for Electric Pits.

As there are no regenerators or checker work required for electric pits, they only require about half the space of gas pits of the same capacity, and when taking into consideration producer space, only about a third of the space is required as compared with a complete producer fired installation. Besides this saving in floor space, there is a large saving in foundation cost and the absence of gas mains and stack enable the electric pit to be more advantageously located with regard to the pit building and the mill. The savings in foundation, floor space, stack and gas mains is such that the installation cost of an electric pit is less than the cost of a modern producer fired installation, and about the same as a modern gas pit well fired with coke oven gas.

TABLE I

Comparison of power required for rolling electrically heated and gas heated ingots. Temperature of the oustide of ingots approximately the same by radiation pyrometer.

	Temp. at 4th pass.	Temp. at 9th pass.	Drop in Temp.	Avg. diff. in peak load.	Avg. diff. in K.w.h.
Electric Ingots ..	2147°	2091°	56°	9% less	25.8% less
Gas Ingots .	2118°	2049°	69°		

TABLE II.

Comparison of electric and gas heating cost, based on electric power at 6 mills per k.w.h. coal at $6.00 per ton gassified, coke oven gas at 12½c per 1000 cu. ft. Metal losses at ¾%, 1¾%, and 2¾% and steel valued at $30.00 and $40.00 per ton.

ELECTRIC HEATING		PRODUCER GAS HEATING	
Ingots charged at 1670 deg.		Ingots charged at 1670 deg.	
Heated to 2350 deg.		Heated to 2350 deg.	
		250 lb. Coal per Ton	
60 K.w.h. at 6 mills....	$0.36	250 lb. coal at $6.00 ton	$0.75
¾% scale at $40 per ton	.30	2¾% scale at $40 ton	1.10
Renewals and Upkeep..	.10	Renewals and upkeep..	.10
Total per gross ton...	$0.76	Total per gross ton..	**$1.95**
ELECTRIC HEATING		PRODUCER GAS HEATING	
Ingots charged at 1670 deg.		Ingots charged at 1670 deg.	
Heated to 2250 deg.		Heated to 2250 deg.	
		167 lb. Coal per Ton	
50 K.w.h. at 6 mills...	$0.30	167 lb. coal at $6.00 ton	$0.50
¾% scale at $30 per ton	.225	1¾% scale at $30 ton	.525
Renewals and upkeep...	.10	Renewals and upkeep...	.10
Total per gross ton..	$0.625	Total per gross ton..	$1.125
ELECTRIC HEATING		COKE OVEN GAS	
Ingots charged at 1850 deg.		Ingots charged at 1670 deg.	
Heated to 2350 deg.		Heated to 2250 deg.	
45 K.w.h. at 8 mills....	$0.48	4000 cu. ft. at 12½c....	$0.50
¾% scale at $40 per ton	.30	1¾% scale at $30 ton	.525
Renewals and upkeep...	.10	Renewals and upkeep..	.10
Total per gross ton..	$0.595		$1.125
60 K.w.h. at 8 mills....	$0.48	167 lb. coal at $6.00 ton	$0.50
¾% scale at $40 per ton	.30	1¾% scale at $40 ton	.70
Renewals and upkeep...	.10	Renewals and upkeep..	.10
	$0.88		$1.30
60 K.w.h. at 1c........	$0.60	167 lb. coal at $4.50 ton	$0.375
¾% scale at $30 per ton	.225	1¾% scale at $30 ton	.525
Renewals and upkeep..	.10	Renewals and upkeep..	.10
	$0.925		$1.00
60 K.w.h. at 1.125c.....	$0.675	1600 cu. ft. coke oven gas at 15c	$0.24
¾% scale at $60 per ton	.225	2¾% scale at $30 ton	.825
Renewals and upkeep..	.10	Renewals and upkeep..	.10
	$1.00		$1.165
60 K.w.h. at 1c.........	$0.60	250 lb. coal at $6.00 ton	$0.75
¾% scale at $60 per ton	.45	2¾% scale at $60 ton	1.65
Renewals and upkeep..	.10	Renewals and upkeep..	.10
	$1.15		$2.50
60 K.w.h. at 3¼c.......	$1.95		
¾% scale at $60 per ton	.45		
Renewals and upkeep..	.10		
	$2.50		

(Continued on page 142.)

The POWER PLANT

Measuring Amount of Air Discharged from Air Ejectors

Suggestions for Installing Test and Recording Instruments

By CHARLES E. COLBURN*

During the last few years a large number of air ejector units have been installed both in new plants and in old ones to replace other forms of air extracting equipment. The later designs of ejector equipment are not only in most cases more economical, but are much more reliable from the standpoint of continuity of operation then the motor-driven equipment. In a great many plants it has been the practice to make periodic determinations of the amount of air leakage in to the main turbine condensers. These records of air leakage have been found to be of great value in maintaining the air leakage at a minimum. For these measurements air bells and gas meters and anemometers have been used. The air discharged from displacement and kinetic air pumps usually contains but a small amount of moisture, due to the temperature being low. In measuring the air discharged from this equipment it is accurate enough for practical purposes to neglect the small amount of moisture and to consider the actual volume discharged as equivalent to the volume of dry air leaking into the condenser. With air ejectors the air discharged from the after condenser is saturated with moisture and the temperature is such that the volume is appreciably greater than the volume of dry air.

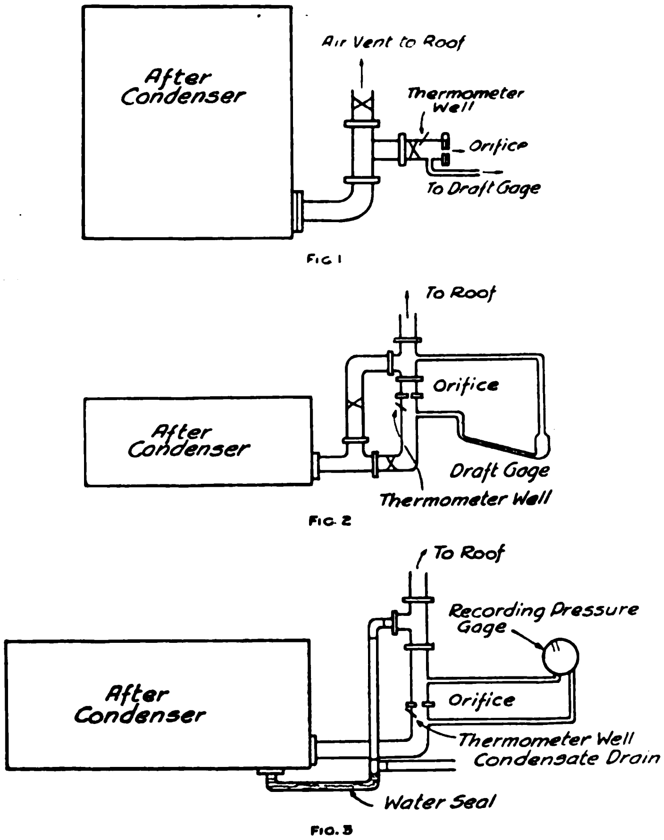


FIG. 1, 2, 3—*Three different methods of installing orifices.*

When air ejectors are used a very reliable and inexpensive device can be installed for measuring the air discharged from the pump. This device consists of an orifice plate and a differential draft gauge or other means for indicating the pressure difference across the orifice. Either of the two methods of installing the orifice as shown in Figs. 1 and 2 may be used. In cases where it is desired to use a recording pressure gauge to give continuous records of the air leakage the piping can be arranged as shown in Fig. 3. This arrangement provides a water seal which will blow out in case the pressure in the condenser should at any time become excessive, as would be the case if an exceedingly large air leak developed or the flow of cooling water through the condenser was stopped. The orifice plates shown in the above figures can be made of approximately .05 in. thick metal and be cut and drilled for inserting between pipe flanges. The orifice size used in the tables accompanying the article was ½ in. diameter. All burrs should be removed from around the hole, leaving the edges sharp and square. A thermometer well should be placed as shown on the high pressure side of the orifice.

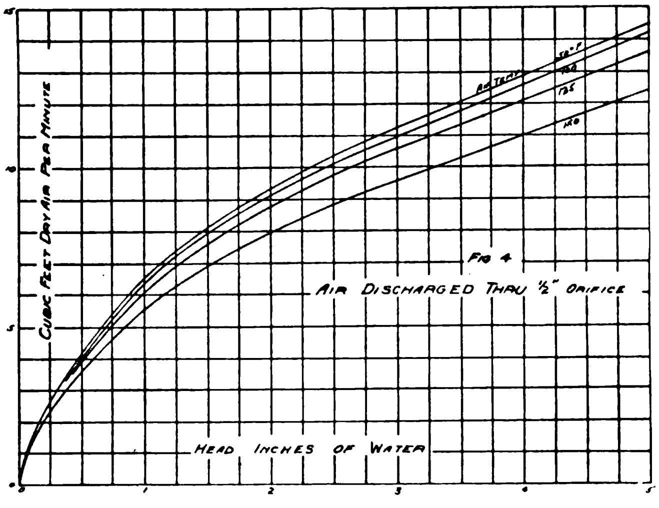


FIG. 4—*Chart used to determine volume of air discharged.*

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*West Penn Power Company, Springdale, Pa.

Before making a test the draft gauges should be leveled and the oil level adjusted to the zero mark. The draft gauge should then be connected to each side of the orifice and the pressure drop and temperature readings taken. From these readings the volume of free dry air discharged can be obtained by using the chart shown in Fig. 4.

In case the volume of air is such that it is necessary to use some other size of orifice, it should be remembered that the volume of air discharged will vary as the square of the diameter of the orifice. That is if a 1 in. diameter orifice was used in place of the ½ in. one, for which the curve in Fig. 4 is drawn, the amount of air discharged will be four times as great as shown by Fig. 4.

The Forging of Automobile Crankshafts

(Continued from page 133.)

In the machining operation the axis of the bearings becomes co-axial with the axis of rotation such that no out of balance occurs from this.

This leaves then the remaining part of the crankshaft, viz., the cheeks, which will contribute materially to the out of balance, both statically and dynamically, of any crankshaft, provided that the axis of rotation and the gravity of the axis of the cheeks do not coincide. The more this gravity axis is displaced from the axis of rotation the more will the crankshaft be out of static and dynamic balance. It is, therefore, readily appreciated that if a crankshaft forging is to be delivered which will give the least possible trouble in machining and balancing, the conditions of the design must be strictly adhered to. This is the purpose of the finishing department in a drop forge plant.

The finishing department must, first, bring all the journal bearings into proper alignment. Second, the finishing department must determine that the angular position of all pins is correct. Third, they must gauge the crankshaft for the spacing of the cheeks to insure proper distribution of the material for the machining operation. Fourth, they must center the crankshafts so that the axis determined by this centering operation will coincide as nearly as possible with the theoretical axis of the shaft. It is readily seen, therefore, that the finishing department in any drop forge shop manufacturing crankshafts, be they fours, sixes or eights, is one of the very important departments in the shop. If the conditions as stipulated do not hold in the crankshaft there will be an excessive amount of labor and trouble in the machining and balancing operations.

This department must, therefore, be equipped with highly specialized machines which will register with a high degree of accuracy the exact conditions of every shaft. With the large number of different types of crankshafts and the variations in these types, it is readily seen that a large amount of equipment to handle the various types is necessary.

In closing let us again repeat that crankshaft forging is today a highly specialized art and requires a vast amount of specialized equipment in order to produce a forging which will satisfy the exacting demands of the automobile builder.

Some Details of the "Holbol" Process

(Continued from page 137.)

pletely closed as the result of this action but the wall of the spherical shell is rendered uniform at all points and the surface receives that hard, smooth, homogeneous texture which is so essential in withstanding repeated shocks.

One of the remarkable features of the Holbol process is that each stage of it is, in itself, a test of the ball. For example, should defective material "slip by" and be converted into blanks, these blanks will not be able to stand the subsequent severe press operations and will thus be automatically eliminated. In the same way the rolling which completes the final operation is a test of the product's ultimate strength, for a ball that can withstand the tremendous pressure of the rolling machine is equal to the most severe service which may be imposed upon it in practice.

Maximum Strength—Minimum Weight.

The core of a solid ball contributes neither to the strength nor to the proper functioning of the ball. This useless core is entirely eliminated in the Holbol, the wall thickness being so calculated that the greatest strength is achieved with the least possible weight. The average wall thickness of a Holbol is from 8 to 10 per cent of the diameter which means a reduction of from 60 to 65 per cent in weight as compared with a solid ball of equal diameter. This, together with the greater resilience, perfect balance and accuracy, should make Holbols the ideal ball for all valve applications.

Monel Metal "Holbols".

The development of the chemical industries as well as the growing realization of the importance of preventing corrosion has made Monel Metal the accepted standard for anti-corrosive materials. The combination of the physical and chemical properties of Monel Metal with the remarkable mechanical features of Holbols produces an article which will fill the evergrowing demand in the valve industries for a light, sensitive, reliable ball of perfect balance, maximum strength and long life.

The Electric Soaking Pit

(Continued from page 140.)

Summary.

The operation of this pit has demonstrated that the quality of heating is uniformly better, due to accurate control of temperature, uniformity of heating, elimination of scale while in the pit, elimination of the cutting of the ingot as in the case of sharp gas flames, and, producing a better surface on the blooms.

The peak power demand on the mills is reduced, as is also the k.w.h. required for rolling.

There is a saving in space required over gas fired pits, making it possible to install twice as many pits in a given space, as well as making a saving in foundation.

When taking into consideration the saving in scale, and with the usual cost of steel mill power, the cost of heating is actually less than by any other means, providing the ingots can be charged into the pits as such temperatures as are now common in steel mill practice.

Further than this, it eliminates the discussions between the open hearth and blooming mill departments as to who caused the trouble in the steel.

TRADE NOTES AND PUBLICATIONS

The Youngstown Sheet & Tube Company, Youngstown, Ohio, has awarded a contract to Arthur G. McKee & Company, engineers and contractors, Cleveland, Ohio, for remodeling their "A" blast furnace of Mayville Iron Company, Mayville, Wis. The furnace, which is at present filled by a bucket arrangement, will be converted to a skip filled furnace, equipped with a McKee revolving distributor and electrically operated bell rigs. Extensive improvements will also be made to the existing ore and coke bins, and the coke bins provided with McKee cascade screens.

The Buckeye Steel Castings Company, at Columbus, Ohio, has placed a contract with the Chapman-Stein Furnace Company, of Mt. Vernon, Ohio, for an additional normalizing furnace to be almost an exact duplicate of the one built last year. The new furnace will have a capacity of 14 heats of 10 tons each per 24 hour day. The cold castings will be heated to 1,650 deg. and allowed to soak at this temperature for about 25 minutes.

The furnace now in operation and the one to be built are designed on an entirely new firing principle. As a result, the bottom of the charge of castings can be heated almost as quickly as the top. This allows the castings at the bottom to soak for a time, whereas in ordinary practice it is practically impossible to get the bottom of the charge up to temperature in time to allow for a soaking period without extra firing ports and excessive fuel costs. The result has been to better the quality of their product.

This furnace is built with Chapman-Stein refractory tile recuperators, which with the improved design of furnace have reduced the oil consumption to 11 gallons per ton of product.

The Carnegie Steel Company, Pittsburgh, Pa., has placed contracts for rebuilding their ore storage bins at Carrie Furnaces Nos. 1, 2, 5, 6, and 7, of Homestead Steel Works, with Arthur G. McKee & Company, Engineers and contractors, Cleveland, Ohio.

This work will include dismantling the present bin bottoms and installing new bottoms of the Baker Suspension Type. All designing, furnishing of materials, dismantling and erection work will be handled by Arthur G. McKee & Company, who will also furnish a 40-ton ore transfer car for filling the above bins.

After 44 years' continuous service with Jones & Laughlin, Mr. Roland Gerry has resigned. Always actively identified with the cold rolling activities of this organization, he has seen its growth from a two-furnace unit to a present capacity of 3,000,000 tons of steel per year. Mr. Gerry carries with him a host of friendly well-wishers.

Mr. D. G. Munroe, formerly general superintendent of the By-Products Coke Corporation of Chicago, has recently joined the organization of the Koppers Company in a contracting capacity. Mr. Munroe has been prominently identified with the by-product coke oven industry for many years.

A new catalog covering the entire Jones line of power transmission machinery, showing list prices, dimensions, weights, horsepowers, and various other specifications has just been issued by the W. A. Jones Foundry & Machine Company, Chicago, Ill., for: Spur Gear Speed Reducers, Cut Spur Gears, Enclosed Worm Gear Drives, Cut Bevel Gears, Friction Clutches, Cut Mitre Gears, Friction Clutch Pulleys, Cut Worm Gears, Ball Bearing Loose Pulleys, Cast Bevel Gears, Sprocket Wheels, Cast Spur Gears, Flexible Couplings, Cast Worm Gears, Belt Tighteners, Cast Mitre Gears, Tension-Carriages, Pillow Blocks, Shaft Hangers, Take-ups, Safety Collars and Rope Sheaves.

One of the largest pipe contracts ever let in one unit was recently awarded by the City of St. Louis, Mo. The contract calls for sixteen (16) miles of 60-in. diameter steel pipe, and this line will supply water to the City of St. Louis from the Missouri River.

James McNeil & Brother Company of Pittsburgh, Pa., were awarded the contract for furnishing this pipe. The pipe will be made at their works, 29th Street and A. V. R. R., and they contemplate shipping about 500 feet of finished pipe every day.

The contract requires about 13,000 tons of steel plates, and contract for the plates was awarded by the James McNeil & Brother Company to the Carnegie Steel Company, who will roll the plates at their Homestead Mills. The shipment of this pipe line will require about 1,000 cars.

Speed reduction and speed reducers play a very important part in the every day operation of steel mills.

A recent development of this character was described in considerable detail in the December, 1924, issue of this magazine.

Since that publication appeared, the patents and business of the Meachum Gear Corporation have been acquired by W. C. Lipe, Inc., of Syracuse, N. Y., and any information desired concerning the above mentioned device may be obtained from W. C. Lipe, Inc. A new bulletin has recently been issued by them which is free upon request.

The Northern Engineering Works with general offices and main plant in Detroit, report the close of a most successful year. They build the Standardized line of cranes, hoists, etc.

The following were elected for 1925, at the recent annual meeting:

President and treasurer, Henry W. Standart; vice president, William V. Moore; vice president and consulting engineer, Edward S. Reid; secretary, Louis H. Olfs; chief engineer, W. Robertson; sales manager, S. E. Schneider; assistant sales manager, W. W. Peattie; advertising manager, G. P. Blackiston; superintendent, R. D. McCutcheon; director of inspection and maintenance, F. A. Eckert; service engineer, E. L. Sheldon; purchasing agent, R. R. Taylor.

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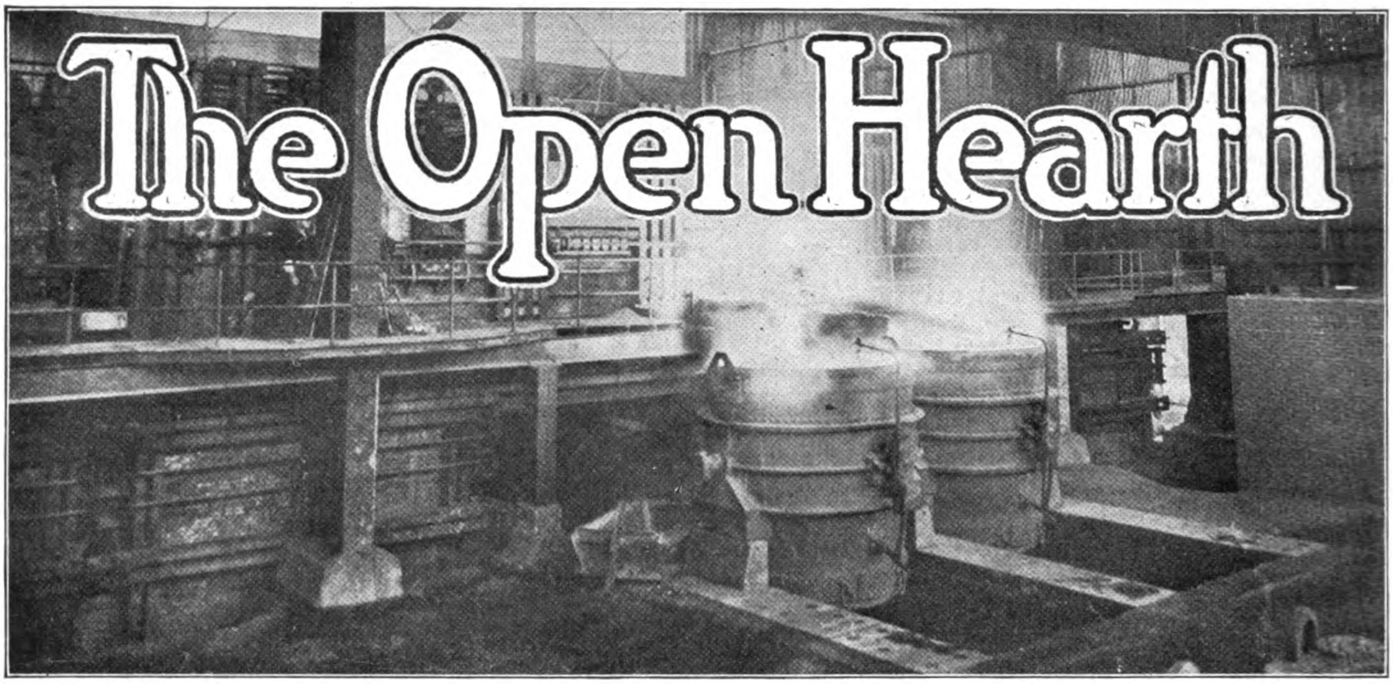


The Open Hearth

P. Blair Lee, who has been engaged in special work for the vice president and general manager of Birdsboro Steel Foundry and Machine Company, Birdsboro, Pa., has been appointed works manager.

E. M. Mentzer, formerly manager of the Weirton Tin Mills of the Weirton Steel Corporation, Weirton, W. Va., has been appointed general superintendent in charge of all tin plate operations of the company. Mr. Mentzer is succeeded by H. G. Richards. E. E. Paddock has been appointed works manager of the Steubenville tin plate division.

George E. Carlin, Hammond, Ind., formerly with the Champion Corporation and the United Boiler Heating and Foundry Company, both of Hammond, has been made general superintendent of the Globe Malleable Iron and Steel Company, Syracuse, New York.

Arthur E. Barlow, for 13 years superintendent of the Wickwire Spencer Steel Corporation, New York, and connected with the business for 36 years under different managements, has been retired on pension.

R. R. Curry, assistant general superintendent of the works at Portsmouth, O., of the Wheeling Steel Corporation, Wheeling, W. Va., has resigned to return to the Allegheny Steel Co., Brackenridge, Pa., as superintendent. He entered the Allegheny company 23 years ago, 12 years later benig made superintendent of the sheet mills and finishing department.

W. Lloyd Wolfe has been appointed superintendent of the Delaware River Steel Company, Chester, Pa. He will have charge of operations of the blast furnace and iron ore dock and other properties of the company. Mr. Wolfe was receiver of the Temple Iron Company with blast furnaces at Temple, Pa. Previously, he operated blast furnaces for the Lackawanna, Bethlehem and Illinois Steel Companies.

Wm. Hayes, recently appointed manager of the wire mills in the Cleveland district for the American Steel and Wire Company, formerly was manager of the wire mills in Chicago territory. Mr. Hayes at one time was assistant manager of the Cleveland Wire Mills, leaving that city for Chicago, in 1916, to take up the position from which he was just promoted.

Vernon C. King has been made director of the safety activities of the Wickwire Spencer Steel Corporation, Worcester, Mass., with headquarters at the Goddard Works, 80 Webster Street, that city. He succeeds Winthrop G. Hall who previously had been service engineer of the Wickwire corporation.

Leon Ehrman has been made blast furnace superintendent of the Belfont Steel & Wire Company, Ironton, O., in charge of the Belfont and Sarah furnaces. He formerly was assistant superintendent of the blast furnaces of the Marting Iron and Steel Company, Ironton. Before going to Ironton he was with the Cambria Steel Company at Johnstown, Pa., and the Tennessee Coal, Iron & Railroad Company at Ensley, Ala.

J. B. Thorpe has resigned as general superintendent of the alloy division of the United Alloy Steel Corporation, Canton, Ohio, effective January 15. Mr. Thorpe came to Canton in 1918 from Gary, Ind., where he had been connected with the United States Steel Corporation. He was graduated from the University of North Carolina in 1903 and has been engaged actively in the steel industry since that time.

The Ford Motor Company, Highland Park, Detroit, Mich., has plans under way for the construction of a new open hearth building at its River Rouge plant, to be one and two-story, 160 x 400 ft., reported to cost in excess of $600,000, with equipment. The installation will include four open hearth furnaces, traveling cranes, conveyors and auxiliary equipment. Albert Kahn, Marquette Building, Detroit, is architect, in charge.

WITH THE EQUIPMENT MANUFACTURERS

Heavy Duty Crusher

The increasing efficiency of other units of the modern power plant, both large central stations and smaller industrial plants, has thrown an increasing burden upon the coal preparation equipment to furnish finer and more uniform sizing of coal with unfailing reliability.

The increasing efficiency of other units of the modern power plant, both large central stations and smaller industrial plants, has thrown an increasing burden upon the coal preparation equipment to furnish finer and more uniform sizing of coal with unfailing reliability.

With the constantly increasing popularity of the single roll type of crusher for stoker coal preparation, crushing coal for pulverizers, gas plant use, and other purposes, has come a corresponding demand for utmost dependability of the crusher unit. This type of crusher has been generally accepted as standard, because of its finer and more uniform product, simplicity of construction, low upkeep cost, and greater dependability.

In operation coal is fed to the crusher in any quantity desired. The rotating toothed roll draws the coal into the tapered opening between the roll and breaker plate, quickly reducing it to the desired size and discharging it below to the belt, elevator, or direct to the bunkers. The cross section illustration indicates clearly the operation of the crusher, as well as the spring relief in case of iron in the feed. The natural agitating action of the teeth passing through the coal on top of the roll produces a shaking action which carries the finer pieces of coal in the feed rapidly through the crushing zone with a minimum of crushing, which partly accounts for the low percentage of fines produced in this type of crusher. The size and adjustment of the spring suspension to prevent the yielding of the springs for any except uncrushable materials, accounts for the minimum of oversize.

With the background of more than 30 years of evolution and development, "Pennsylvania" Single Rolls have passed through the cast iron stage into steel frame construction. These crushers have now been perfected in the "Pennsylvania" Armorframe series of single roll coal crushers.

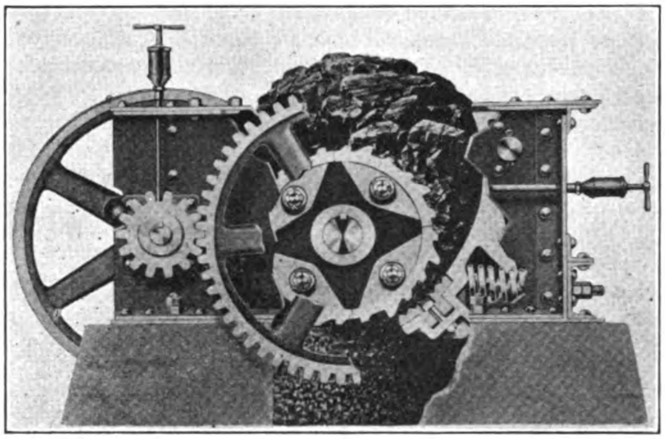
For average conditions and capacities in power plant work the nearest approach to the ideal coal preparation service rendered by the Bradford Breaker on large tonnages, is obtained from the single roll crusher. Minimum oversize and minimum fines have always been characteristic of this type, and with unbreakable fabricated steel frame construction, in addition to two other safety devices, the danger of breakdown from tramp iron in the feed is definitely eliminated.

Bethlehem Section 30 in. I-beam girders form the side frame construction of these crushers as shown in the accompanying illustration. Cross members of heavy channel and angle plate are hot riveted to the girder beam side frames to form the rigid unbreakable unit construction. Electric steel bearing housings, accurately shouldered into the side frames to take the shear, and hot riveted in position, are fitted with interchangeable die cast bearing bushings, and thorough lubrication is provided by steamboat type grease cups piped to "Safety First" locations.

A segmental roll of special patented construction with no bolts through the crushing surface to weaken the segements, affords greatest strength and provides ready accessibility for changing when rarely necessary.

The frame carries, in addition to the main roll shaft and the countershaft, a pivoted breaker plate which is readily adjustable to and from the crushing roll to vary the size of product as needed. A 1 in. product with little oversize can be supplied for stoker feed or for pulverizers; 6-in. crushing for preparation of coal for hand-fired locomotives is equally possible. Any size between these two limits is easily obtained by means of the breaker plate adjustment.

Supporting the breaker plate are heavy compression springs, designed to yield for the passage of tramp iron or other uncrushable materials, but which will not permit the passing of oversize coal through the choke feeding of the crusher. The Armorframe operates equally well without feeder and regardless of the amount of coal in hopper or bin over the roll.



Besides the spring suspension of the breaker plate, a special safety device employing an ordinary steel bolt in hardened steel bushings prevents breakdowns in case of large iron in the feed. In normal operation this bolt transmits power from the flywheel, to the yoke which is keyed to the shaft. This safety device is positive in operation. Both the pinion on the countershaft and the heavy main gear on the crushing roll shaft have cut teeth to insure smooth operation.

Triple protection against tramp iron is thus afforded in this crusher, first with the unbreakable steel frame, second with the relief springs, and third with the positive shear pin safety device.

In this design the wearing parts are all in plain sight and can be readily inspected. This accessibility helps to avoid accidents and shutdowns which may result from concealed or inaccessible wearing parts.

(Continued on page 148.)

Some Pointers on By-Product Coke Oven Operations

Book Review

By F. J. Crolius

"Coal Carbonization," by Horace C. Porter. 442 pp. 1924. Cloth, $6. Chemical Catalog Company, Inc., 19 E. 24th Street, New York City (American Chemical Society, Monograph Series.)

In these days of specialization it is increasingly difficult to keep pace with technical progress, and there is always a welcome for a new book, which bears the stamp of authority, and which affords an adequate survey of any important industry.

Not the least gratifying feature of a technical book is a preface in which the author directly and concisely tells the reader exactly what he intends to do. As an example of what a preface should be, there are few better instances than that in Dr. Porter's "Coal Carbonization," and the following review, which is primarily descriptive rather than critical, is based in part upon this preface and upon the introduction by Prof. S. W. Parr, who, like the author, is well known in the field of fuel technology.

Of the rather limited number of books on coke appearing during recent years, the greater number have been European, and most of those in the English language have been produced in England where many of the problems are essentially different from those in the United States. There is, therefore, ample justification for a book by an American writer, and the author, a chemical engineer for many years engaged in fuel investigation with the United States Bureau of Mines, and for a time with the Koppers Company, brings to his task a rich fund of scientific training and technical exerience.

For approximately 75 years, or until the end of the nineteenth century, the carbonization of coal was carried on in substantially the same way as at the outset, with but slight attention to modifications or improvements, but, during recent years, many highly trained specialists have given their attention to unfolding the complexities of the subject, and great progress has been made. As a consequence, the subject of coal carbonization is now too extensive to be treated exhaustively in a single volume. The present work, however, is comprehensive, and is thorough to the extent of outlining the economic situation, incorporating the essential theory, describing the industrial equipment for coal carbonization and explaining its operation, and discussing the more important products. The book is provided with copious footnote references to original sources of information, and it is significant of the rapid recent development in this field, that most of the references which the author finds it worth while to cite are to literature published within the last four or five years.

The book does not deal with historical development nor with equipment now obsolete, but is concerned with present (and to a limited extent, future) conditions. The treatment is well balanced. The author sponsors no one system, but attempts to give a typical cross-section of the industry today. It is an unbiased treatise in which topics are treated in accordance with their relative importance as determined by the present status and trend of the industry.

Chief attention is given to coking and gas making at high temperatures. Today, on the basis of capital investment and value of products, by-product coking constitutes seventy-five per cent of the carbonization industry in America, and gives promise of retaining a relatively prominent position for some time to come, and we find that approximately half the book is devoted to the working of by-product coking plants, various types of by-product ovens, heating of the ovens, and recovery of by-products. The description of ovens is confined to types in use in the United States, and these are described in great detail with numerous illustrations and diagrams. A list of other types is given with citation of references to descriptive articles thereon, thus giving the book a reference value beyond the scope of the text.

Low temperature and miscellaneous processes are dealt with briefly, two chapters dealing respectively with "The Gas Industry" and "The Processes of Gas Manufacture by Coal Carbonization," and the final chapter is concerned with "The Application of the Products of Coal Carbonization." An appendix contains a number of useful tables and charts on such subjects as oven charging, composition of coals, yield of coke, and plant lay-out. One of the most interesting is a chronological table of by-product coke plants in the United States. The fact that this table has been corrected up to March 1, 1924, is but one of the evidences throughout the book that the author has brought his work well up to date.

The book is primarily "for the average technically trained man, chemist, business executive or engineer, who requires a knowledge of the principles and an outline of the practice in coal carbonization." Though it does not go into great detail regarding the uses of coke, it will be of service in the steel industry as blast-furnace gas is now an important item in coke manufacture, and more than three-fourths of the coke produced finds application as blast-furnace fuel.

Dr. Porter's "Coal Carbonization" is easily one of the most directly useful of the "Monograph Series," being issued under the auspices of the American Chemical Society. Like many (but not all) of the other works in this series, it contains a table of contents which is more than a mere list of chapter headings. This detailed table of contents is a valuable feature which should be embodied in every technical book, as it is the only medium through which the reader is enabled to make a quick survey of the scope and arrangement of the work. Such a table of contents should not be expected to perform the functions of an index, but in the present work, it may serve to supplement the "Index of Subjects" which is carelessly made and very inadequate. Judging by evidences of inconsistency with the orthography of the text, this "Index of Subjects," is not the work of the author. There is little attention to synonyms and

(Continued on page 148.)

NEWS OF THE PLANTS

The Bethlehem Steel Company, Bethlehem, Pa., has authorized plans for extensions and improvements at its steel mills and blast furnaces at Steelton, near Harrisburg, Pa., to consist of the installation of additional equipment in a number of departments. An important feature of the project is the complete electrification of the works, replacing all present steam-operated equipment. The project is estimated to involve close to $2,000,000, with machinery. The company is also proceeding with expansion plans at its Sparrows Point, Baltimore, Md., to include the erection of a new wire mill, reported to cost in excess of $250,000, with equipment. Other departments of the works will be improved.

The Coplan Steel Company, Ogdensburg, N. Y., has completed the erection of the initial unit of its new local plant, occupying a portion of a 10-acre site on the St. Lawrence River, and will proceed with production, intending to develop the plant to maximum capacity at an early date for the production of special heat-resisting steel specialties. The main building is 85 x 300 ft. Other structures, it is stated, will be constructed at a later date. A. Coplan is president of the company.

The Inland Steel Company, Chicago, Ill., is arranging an expansion program at its plant at Indiana Harbor, Ind., during the present year to cost approximately $7,500,000. The work will include the erection of a number of new mills and the installation of additional machinery for large increase in output. The company also plans the construction of a new blast furnace and purposes to begin work on the unit at an early date. Other work includes the installation of a new battery of about 30 coke ovens, and accessory equipment, as well as the complete electrification of the plant departments, replacing present steam-driven apparatus with new equipment. During the past year, the company has completed a number of new open-hearth furnaces, as well as constructed a merchant bar mill and billet mill. These structures are now in service.

The Jones & Laughlin Steel Corporation, Pittsburgh, Pa., is said to be arranging for preliminary work at the site of its proposed new steel mills at Hammond, Ind., including surveying, dredging and grading work. The plant will consist of a number of units for billet, bar, steel fabricating and other service, with power house and auxiliary structures, estimated to cost in excess of $25,000,000 for ultimate consummation. Details of the different buildings are being withheld for the present. The company acquired a large tract of land for the plant several months ago.

A new corporation is now being formed by I. P. Blanton, Ironton, Ohio, and associates for the construction of a new local steel mill, for which it is expected to perfect plans at an early date. The Freyn Engineering Company, 1638 Straus Building, Chicago, Ill., formerly known as Freyn, Brassert & Company, has been engaged to prepare plans and specifications for the plant, which is estimated to cost in excess of $1,000,000, with machinery. It will consist of a blast furnace and a number of mill units, with power house and auxiliary structures. Work is scheduled to begin in the spring, when plans for company organization will also be consummated.

The Carnegie Steel Company, Pittsburgh, Pa., is perfecting plans for the early installation of equipment for extensions at its plant at McDonald, Trumbull County, Ohio, for which buildings were erected a number of months ago. The expansion will carry out the original program at the plant, consisting of a 10-inch shape mill, 14-inch bar mill and 12-inch strip mill. The addition will bring the plant quota up to nine mills, and is estimated to cost in excess of $1,500,000, complete. Orders for the machinery will be placed at an early date, with intention of proceeding with the work in the spring.

The Youngstown Sheet & Tube Company, Youngstown, Ohio, has plans in progress for expansion in its mills in Indiana and other points during the present year, including blast furnace construction and remodeling of existing units, new mills for sheet and tinplate service, open hearth furnaces and miscellaneous structures, to cost more than $5,000,000. J. A. Campbell is president.

The Pittsburgh Steel Products Company, Union Arcade, Pittsburgh, Pa., has plans under way for the construction of a new addition to its plant at Allenport, Pa., consisting of a main mill unit, 140 x 1,000 ft., to be equipped for the rolling of seamless tubes from 6 to 12 inches in diameter. The plant is being designed for an initial output of 5,000 tons per month, advancing the total works production to about 16,000 tons monthly. The installation will include a number of traveling cranes and auxiliary machinery. To provide for the expansion, the company has recently disposed of a bond issue of $3,000,000, of which about $1,000,000, will represent the investment in the new structure. Emil Winter is president of the company.

The Mayville Iron Company, Mayville, Wis., has completed plans for improvements and remodeling of its local blast furnace, designated as stack A, and will proceed with the work at an early date. The unit will be converted from one of bucket fill to skip-filled type, with the installation of skip hoists, revolving distributor and electric-operated bell rigs. The company will also make improvements in its ore and coke bins, as well as carry out a number of minor betterments for increased plant efficiency. The work will be handled by Arthur G. McKee & Company, Cleveland, Ohio, engineers and contractors.

The Somerville Iron Works, Inc., North Chattanooga, Tenn., has plans under consideration for extensions and betterments in its local plant, to consist of new buildings and the installation of additional equipment for considerable increased capacity. The project is estimated to cost close to $150,000; details are expected to be consummated at an early date.

The Atlas Alloy Steel Corporation, Dunkirk, N. Y., has been organized by creditors of the Atlas Steel Corporation, to take over the local mill, recently acquired at a receiver's sale by Frank R. Collins, Buffalo Trust Company, Buffalo, N. Y., acting for the officials of the new organization, for a consideration of $250,000, subject to mortgages and other secured accounts. The new company purposes to make necessary improvements at the plant, including machinery replacements, and to begin operations in the near future.

Heavy Duty Crusher

(Continued from page 146.)

Coal crushers are naturally subject to neglect and abuse, and rarely get any attention except for occasional lubrication. It is imperative, therefore that they be of powerful construction to successfully withstand this kind of usage. The "Pennsylvania" Armorframe, in spite of abuse and neglect, can be depended upon for unfailing coal preparation, free from tramp iron troubles. This Armorframe series opens a new chapter in modern coal preparation, affording dependability, product of required size, and minimum cost of preparation per ton—indefinitely.

Book Review

(Continued from page 145.)

cross-indexing and it fails to bring out satisfactorily the subject matter of the text. For example, there is only a single entry under "By-product," and only one under "Costs".

The book is a creditable one. In the words of Professor Parr's Introduction, "The author is peculiarly well fitted by both training and experience for his task and as a result there has been brought together a fund of information not otherwise accessible in any compact and convenient form. His treatment of the entire field has been impartial, conservative and scientific, and both the author and the industry are to be congratulated on the result."

Homestead Valve Expands

The following mill and mine distributors have been appointed as agents for the Homestead line. They will handle Homestead Quarter Turn Valves used in almost every industry, the Hovalco-Homestead Combination Blowoff Valves, the Homestead Protected Seat Globe Valve and Hydraulic Operating valves and all other products of the Homestead Company. They will carry a stock of this material and be prepared to render service to users or prospective users at all times. W. A. Case & Sons, 72 St. Paul St., Rochester, N. Y.; the Fulton Supply Company, Atlanta, Ga., and Charles A. Setzer, manufacturers' agent, 725 Realty Bldg., Charlotte, N. C.

Additional Trade Notes

The U. G. I. Contracting Company, Philadelphia, has received contract to furnish and install electric vibrating screens in connection with the new carbonizing plant of the Syracuse Lighting Company at Syracuse, N. Y. By means of these screens the coke will receive a screening treatment that could not be effected by the ordinary screen processes and it will enable the Syracuse Lighting Company to deliver to its customer a cleaner and more satisfactory domestic fuel than would otherwise be the case.

The electric vibrating screen system is a new departure in connection with the handling of coke, and is meeting with considerable success.

The U. G. I. Contracting Company, of Philadelphia, has secured contract for and is preparing to install, in conjunction with Wilputte Coke Oven Corporation, two 10-ft. sets of blue gas-apparatus at the plant of the Perry Iron Works in Erie, Pa. The apparatus will be of the U. G. I. cone top type and the generators will have hopper bottoms. The blue gas will be used for firing the ovens.

In addition to the blue gas apparatus, the contract calls for the installation of blowing plant, hydraulic pumping system, exhaust steam system, scrubbing equipment, charging larry and ash cars. With the blue gas apparatus, there will be installed two U. G. I. Model "B" outomatic controls.

In addition to making the installation, the U. G. I. Contracting Company will also design all steel and architectural drawings required for the work.

The Perry Iron Works is a property of Pickands, Mather & Company.

In addition to the contract which it has already been awarded, the U. G. I. Contracting Company, Philadelphia, has received the order from the Public Service Production Company to furnish and install U. G. I. high duty salt water gas condensers at the new plant in Harrison, N. J. There will be four condensers in the system, of capacity sufficient to handle about 30,000,000 cu. ft. daily.

These condensers as designed for the Harrison Plant incorporate the efficiency of the fresh water condenser, together with the protection against corrosion due to the use of salt water.

The plant of the Delaware River Steel Company enjoys the advantage of being the only merchant furnace located directly on tidewater in the United States, and in order to provide for the unloading of foreign ores, a new dock will be built, the contract for same having been placed with J. E. Brenneman & Company of Philadelphia, Pa.; upon which will be operated a fast plant as designed by the Brown Hoisting Machinery Company of Cleveland, Ohio.

Okonite Opens St. Louis Office

In order to best serve the interests of their customers in the middle west, the Okonite Company, Passaic, N. Y., manufacturers of insulated wires and cables, have opened a sales office in St. Louis at 444 Frisco Building, with Mr. L. R. Mann in charge.

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MAR 11 1925

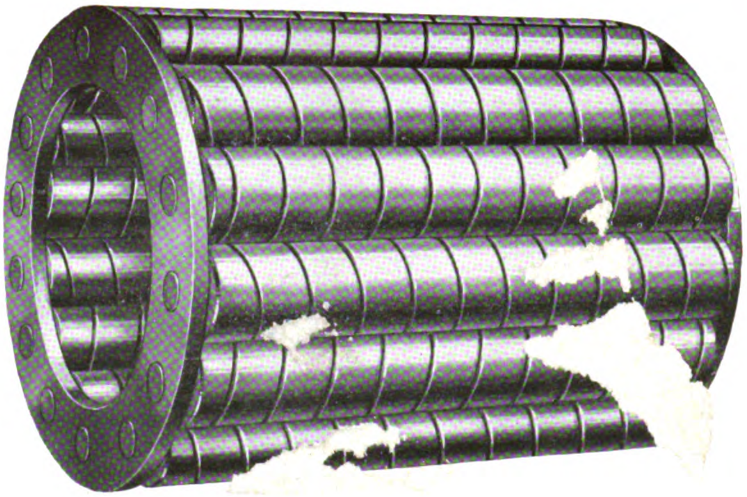
The Blast Furnace and Steel Plant

Member of the Audit
Bureau of Circulations

PITTSBURGH, PA., MARCH, 1925

Entered as second class mail matter at Pittsburgh, Pa., under the act of Congress, March 3, 1879.

Bearings
Designed
For
Steel Mill
Service



HYATT steel mill bearings are the result of the best efforts of the Hyatt engineers plus the recommendations of practical steel mill engineers.

The type of bearing shown above was developed to meet the demands of steel mill service and was designed particularly for mill table equipment.

The sturdy, helically wound rollers assembled into strong compact units have endurance built into them that insures easy running cars and table rollers. Years of reliable service without adjustment or replacement is their performance record. They reduce the cost per ton by cutting lubrication and maintenance costs.

Our engineers are prepared to submit Hyatt bearing designs and estimates for your equipment, without obligation. Communicate with our Pittsburgh, Chicago or Philadelphia office.

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